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FORESTRY BEST MANAGEMENT PRACTICES IMPLEMENTATION MONITORING

THE 1990 FORESTRY BMP AUDITS FINAL REPORT

MONTANA DEPARTMENT OF STATE LANDS
FORESTRY DIVISION
MISSOULA, MONTANA 59801

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FINAL REPORT

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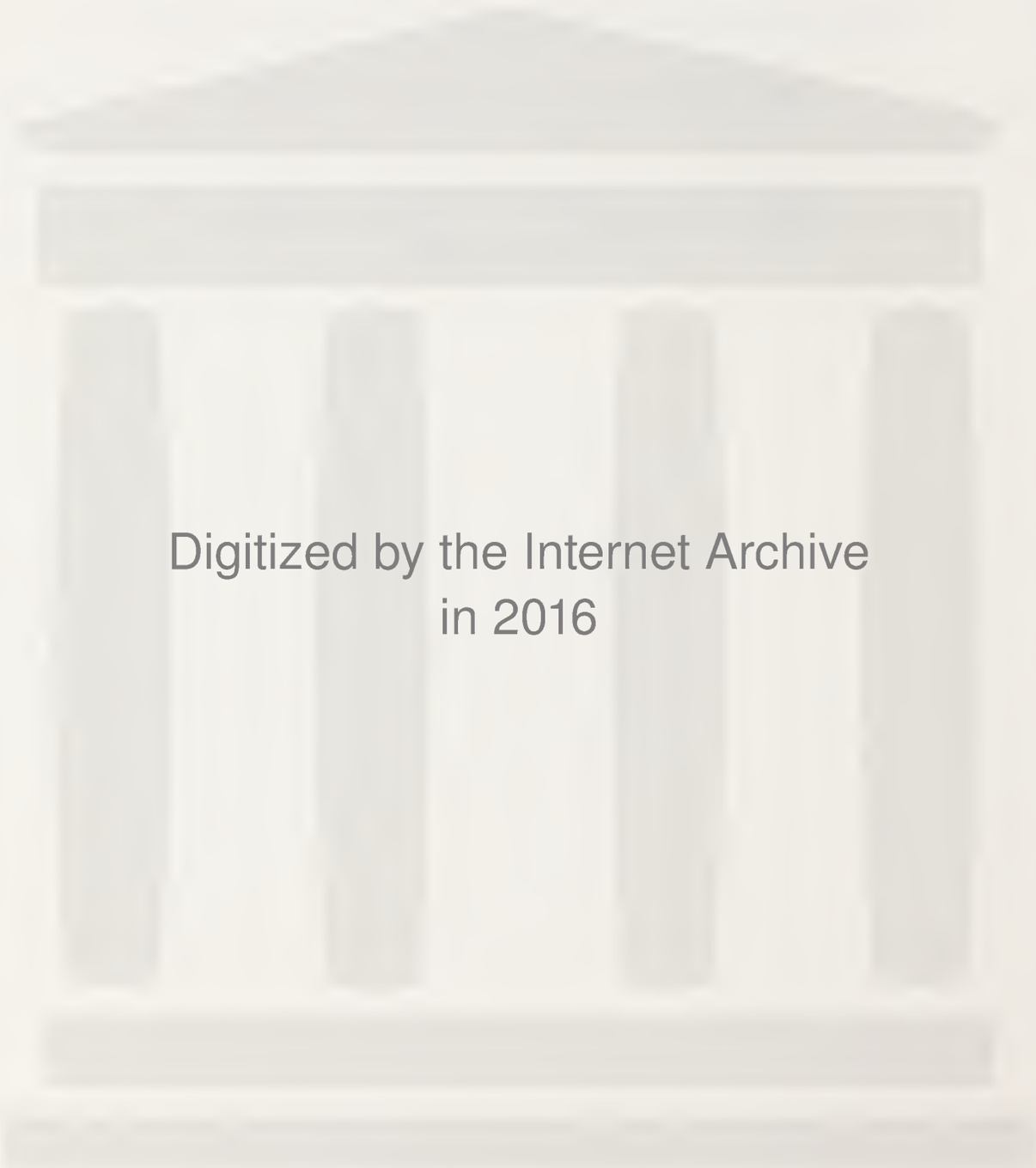
FORESTRY DIVISION
MISSOULA, MONTANA 59801

Report Prepared by Bill Schultz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ACKNOWLEDGEMENTS

The Forestry Division of the Montana Department of State Lands is deeply indebted to the many people who gave their time and energy to the 1990 forestry BMP field audits. Thanks to the Environmental Quality Council for recognizing the significance of the forestry water quality issue and for mandating that the audit process be conducted in 1990. Thanks to the work group members who gave direction to the project. Thanks to all who supplied information to select the sites and who gave access to private lands. Special thanks to the audit team members who travelled extensively, worked long days in the field, and made lots of hard decisions in a professional manner. Don Essig did a fine job compiling the results of the audits and producing the figures. Katie Mac Millen provided excellent editorial assistance. Thanks to Lucy Borer for typing the document.

EXECUTIVE SUMMARY

The Best Management Practice (BMP) audit process is used to evaluate whether BMPs are being applied and whether they are effectively limiting non-point source pollution. In 1989, the Montana Legislature directed the Montana Department of State Lands (DSL) Forestry Division to evaluate forest practices for BMP implementation and report to the EQC before the 1991 legislative session. This report summarizes the findings of Montana's 1990 forestry BMP audits.

Three teams conducted the audits. Each audit team was composed of six members: a fisheries biologist, a forester, a hydrologist, a representative of a conservation group, a road engineer, and a soil scientist. DSL used site selection criteria to randomly choose 44 timber harvest sites harvested since 1988. The audit teams evaluated a maximum of 58 practices at each site, rating application and effectiveness for each BMP on a 5-point scale. The selection criteria limited the sample to those sites most sensitive to the practices that affect water quality.

None of the sites audited were subject to the notification and information requirements of H.B. 678, which the 1989 legislature passed and which went into effect January 1, 1990. Under H.B. 678, landowners and loggers receive information about BMPs and an on-site consultation for proposed operations in sensitive areas. H.B. 678 has also spawned new BMP education. Further evaluation will be required to measure the benefits of H.B. 678.

The audit teams evaluated a total of 1780 practices for BMP application. Seventy-eight percent of the practices rated on all sites met BMP requirements. Readers should use caution in basing their conclusions on these simple percentage ratings. Practices vary greatly in their potential impact. Looking at nine high risk BMPs, 53% of the practices met BMP requirements. High risk BMPs are among those most important for protecting watersheds. Nearly all sites--43 of 44--had at least one minor departure from BMP application; 27 of 44 sites had at least one major departure. Non-industrial private lands averaged 16 departures per site, the highest among all ownership groups. The average for all ownership groups was nine departures per site.

The audit teams evaluated a total of 1778 practices for BMP effectiveness. Eighty-one percent of the practices rated on all sites were judged to provide adequate protection. Readers should use caution in basing their conclusions on these simple percentage ratings. Looking at the nine high risk BMPs, 58% of the practices were rated as providing adequate protection. Eighty percent of the sites audited were producing minor, temporary impacts to the soil and water resource; 64% of all sites had major, temporary or minor, prolonged impacts; 9% of the sites had at least one major, prolonged impact. The average number of minor, temporary impacts per site was 4.4; the average number of major, temporary or minor, prolonged impacts per site was 3.0; the average number of major, prolonged impacts per site was 0.6.

On 21 of the 44 audit sites, teams noted that a change in stream crossing design would have prevented or reduced sediment discharge. The average length of streambank left unshaded was 118 feet. Ground skidding through a perennial stream occurred on 2 of the 44 sites. The average streamside management zone was 43 feet wide. Overall, the wider the SMZ, the fewer impacts in the SMZ from harvest practices. The greatest departure from BMPs, and the most impacts, were associated with roads--primarily road drainage and road construction. The text includes a list on pages 25 and 26 of problematic BMPs and BMPs that are usually applied properly.

Federal lands consistently rated higher than other ownership groups in application and effectiveness of BMPs. State lands ranked second, followed in order by industrial private and non-industrial private lands.

The 1990 audits generally resulted in lower ratings than those of previous audits. 1990 audit ratings are only slightly lower than the 1988 EQC audits when compared with overall percentage ratings. However, the 1990 audits found a higher percentage of sites with major departures and impacts than previous audits. The 1990 audits also found a higher average number of major impacts per site than earlier audits did. In the 1988 audits, 3.3 percent of the practices rated on each site resulted in major impacts; in 1990 this was up to 8.6 percent.

There are several possible reasons for differences in ratings among the three audits that may offer further understanding of the lower ratings:

- The 1990 audits met the criteria for selecting high hazard sites and therefore looked at more sites with potential problems than other years had.
- More sites with new roads were evaluated due to a change in the selection criteria. New roads are usually the main source of sediment from timber harvest sites.
- Definitions were added to the effectiveness rating. These definitions had not existed for previous audits.
- Team members had a clearer definition of a "stream," and therefore a better idea of where SMZ BMPs applied.
- Climactic differences. The drought that occurred in 1988 may have made it hard to judge impacts. Runoff conditions have been closer to average for the 1990 audits.
- For consistency, the work group approved a rationale flow chart that the teams used to decide ratings on site. See Appendix E.
- More practices were evaluated. The form was revised to include additional BMPs.

RECOMMENDATIONS

- Continue the interdisciplinary BMP audits, whether under a non-regulatory or regulatory program. The audit process has been fundamental in educating and making people aware of BMP requirements.
- Two-thirds of the audit team and work group members attending the October 10, 1990 post-audit meeting recommend that the audits be conducted on an annual basis for several years, in order to make landowners and timber operators more aware of forestry BMPs. The rest of the members present felt that conducting the audits every two years would suffice.

- Form a committee to study and rectify perceived inconsistencies of the hazard reduction requirements, BMP goals and silvicultural objectives for reforestation.
- Adjust BMPs where the audits point out weaknesses. Use the notes that resulted from the 1990 audits; DSL has kept these notes.
- Continue educating loggers, landowners, and foresters, concentrating on problem areas documented through BMP audits.
- Keep future audits consistent with past audits to provide a relevant means of comparison.
- Actively encourage the sites' logging contractors to attend the audit. At a minimum, give contractors a copy of the audit results for their sites.
- Develop a system to remedy specific problems found during audits.
- Continue funding volunteer audit team members.

INTRODUCTION

The forest lands of Montana supply the State with forest products and large quantities of high quality water. The logs fuel lumber and plywood mills and other facilities that manufacture wood products. The high quality water nurtures some of the west's best fisheries, and provides water for irrigation and livestock, and for domestic, recreational and industrial purposes. All products from Montana's 22.5 million acres of forest land contribute in an essential manner to Montana's economy and way of life.

Montana's water quality protection program for forestry involves a non-regulatory approach (and, since 1990, a notification requirement for private landowners who plan to harvest timber.) Concern over the impacts of timber management on the State's watersheds prompted the 1987 Montana Legislature to pass House Joint Resolution 49. This resolution directed the Montana Environmental Quality Council (EQC) to study "how current forest management practices are affecting watersheds in Montana." The EQC chose to audit Montana's forest practices for Best Management Practice (BMP) use, as one of the methods to study watershed effects. BMPs were originally developed in the 1970's through mandates of the federal Clean Water Act. The EQC, through the BMP technical committee, revised Montana's forestry BMPs in 1988 as a result of HJR-49.

Montana's forestry BMPs provide minimum standards for how to conduct forest practices in ways that protect water quality. The BMPs, if written well enough and applied, can limit non-point source pollution--the kind of diffuse pollution that forestry operations often produce, such as sediment from a road or timber harvest. The BMP audit process is used to evaluate whether BMPs are being applied and whether they are effectively limiting non-point source pollution.

As part of HJR-49, audit teams conducted the first State-wide assessment of forest practices for BMPs during the summer of 1988 (Zacheim, 1988). In 1989, the University of Montana, under the Flathead Basin Water Quality and Fisheries Cooperative, audited more sites for BMPs in the Flathead River drainage (Ehinger and Potts, 1990.) Also during 1989, the Montana Water Quality Bureau submitted a non-point source management plan to the EPA, as required by Section 319 of the Federal Clean Water Act. The EPA granted conditional approval of the silvicultural part of the plan. A condition of the EPA's approval was that Montana continue to audit its forest practices, with some new questions added to the audit format to address several issues that had originally not been covered. Forest practices contribute to the impairment of 13% of the impaired stream-miles in Montana, according to Montana Water Quality, 1990 (DHES, 1990).

In 1989, the Montana Legislature directed the Montana Department of State Lands (DSL) Forestry Division to conduct another round of audits, evaluating forest practices for BMP implementation, and report to the EQC before the 1991 legislative session. This report summarizes the findings of Montana's 1990 forestry BMP audits.

The BMP audit process, which the EPA calls BMP implementation monitoring, is a widely used means of evaluating forest practices. Implementation monitoring is a surrogate for water quality monitoring, a more quantitative approach. Water quality monitoring is a long-term and expensive endeavor. Water quality varies naturally, due to variable geology, land forms, soils, and climatic events. Due to this variability, investigators have to collect large numbers of samples at the right time and over a long period of time to accurately characterize water quality. Often, there is no baseline, or pre-disturbance, data to compare.

Investigators use qualitative audits to find out if BMPs are being applied and whether they are controlling erosion; they can use quantitative water quality monitoring to determine if BMPs are protecting beneficial water uses. Since BMPs are recognized by State and federal legislation as a method to control non-point source pollution, it makes sense to check the application and effectiveness of BMPs as part of a such a program. States are increasingly relying on qualitative surveys, using interdisciplinary teams to assess forest practices on-site, to monitor their silvicultural non-point source control programs (NCASI, 1988). California, Idaho, Oregon, Utah, Washington and Florida all use a qualitative approach to assess the control of non-point source pollution.

METHODS

The DSL Forestry Division worked closely with the EQC in planning the 1990 BMP field audits. The EQC reviewed and approved the objectives and timeline for the audits.

The objectives for the 1990 BMP Field audits were to:

1. Evaluate if BMPs are being applied on timber harvest operations.

2. Evaluate the general effectiveness of BMPs in protecting soil and water resources.

3. Provide information on the need to revise, clarify, or strengthen BMPs.

4. Provide information to focus future study efforts by identifying subjects and geographic areas in need of further investigation.

From the beginning, DSL sought a broad range of participants for the audits. In March, 1990, DSL mailed out approximately 275 response forms, to all the addresses on the EQC's HJR-49 mailing list and to other interested parties. The recipients could respond saying they would like to join the work group or an audit team, receive the final report, or that they were not interested. 95 response forms were returned. 27 people said they would like to be in the work group. 55 people said they would like to be part of an audit team.

The Work Group

DSL put together a work group to plan the audits. The work group represented a variety of interests, including a number of forestry and water quality concerns. See Appendix A for a list of members. The main tasks for the work group were to:

- choose the audit team members;
- approve the rating guide and field rating form;
- approve the criteria for selecting sites; and
- review the draft of this report.

The Audit Teams

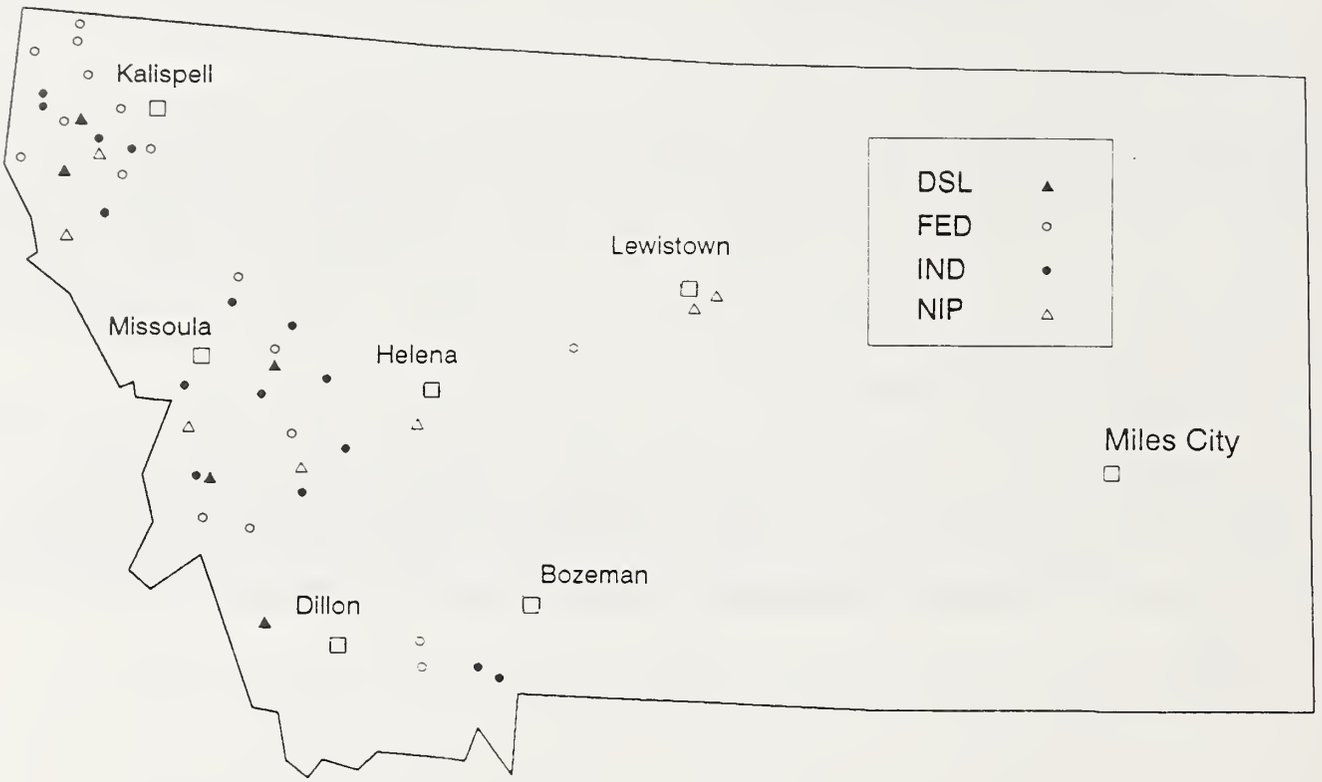
The work group designated three audit teams--one for the northwest, one for the west central, and one for the southwest and east parts of the State. Each team was composed of six members: a fisheries biologist, a forester, a hydrologist, a representative of a conservation group, a road engineer, and a soil scientist. The legislature provided funds to pay volunteer members who could not participate as a part of their regular job. Rates were $50 per day, plus State per diem expenses. Although the wage was nominal, it was enough to draw several highly qualified individuals.

The work group named an alternate for each member, in order to insure a full range of interdisciplinary participation at each site. See Appendix B for a complete list of team members. A member of each audit team was assigned to lead the team. The team leader was responsible for filling out the consensus rating form and for overseeing the logistics of the team.

The Study Area

The work group limited the study area to the western half of the State, where a vast majority of the timber harvest operations in Montana occur. The most easterly sites they selected were in the Lewistown area.

MAP # 1. GEOGRAPHIC DISTRIBUTION OF AUDIT SITES



DSL = Dept. of State Lands

FED = Federal

IND = Industrial Private

NIP = Non-Industrial Private

Site Selection

The work group adopted criteria for selecting sites based on the criteria for the 1988 and 1989 BMP audits. Their purpose in defining the criteria was to concentrate on sites that were likely to have potential for water quality impacts. After the criteria were defined, actually selecting the sites became the responsibility of DSL.

1990 BMP FIELD AUDITS
SITE SELECTION CRITERIA

DSL used the following criteria to select sites:

- Areas needed to have timber harvested in 1988, 1989, or 1990. Priority was given to the most recently harvested sites.

- Part of the site needed to be within 200 feet of a stream. (see definition of stream in Montana's BMPs.)

- The harvest unit needed to be at least five acres and have at least 7,000 board feet per acre removed. Some flexibility was allowed on this point if smaller units or lower volume harvest met other criteria.

- The distribution of audit sites needed to reflect the geographic and ownership distribution of timber harvest in Montana.

- Sites were classified into four land ownership groups: federal, industrial private, non-industrial private, and state. The number of audit sites per ownership group was to be roughly proportional to the volume of timber harvested by the ownership group in 1988. However, each ownership group was to have a minimum of five sites audited.

DSL further sorted the sites that met the initial criteria:

- Sites with road construction or reconstruction and slash already disposed of were given first priority.

- Sites with road construction or reconstruction but slash remaining were given second priority.

- Sites with slash already disposed of but no road construction were given third priority.

Finally, the sites were ranked by erosion hazard:

- The work group determined erosion hazard as a function of slope steepness and erodibility, using a risk matrix developed by the Montana Riparian Association. See Appendix C. Timber harvest in riparian zones was automatically categorized as high hazard.

- Two-thirds of the audits were to be located on high hazard sites. One-third was to be located on low to medium erosion hazard sites. This division was similar to the 1988 EQC HJR-49 audit and was subject to availability of sites in the various hazard groups.

The primary differences from how the sites had been selected in previous years were that in 1990 the work group emphasized sites with new road construction, and used a revised hazard rating system.

The number of days that team members would be able to conduct audits limited DSL to choosing 44 sites for the teams to visit. The work group set the maximum time commitment for audit team members at 10 days, since a longer commitment would likely jeopardize the ability of individuals to participate. On most days, teams could audit a maximum of two sites. The work group assigned each team to review 14 or 15 sites. See Appendix F for the list of the sites and schedules. The four ownership groups and number of sites audited were:

OWNERSHIP GROUP	NUMBER OF SITES AUDITED
Federal (USFS and BLM)	16
Industrial Private	16
Non-Industrial Private	7
Dept. of State Lands	5
TOTAL	44

The goal for the audits was to have two-thirds of the sites in the "high hazard" category, as explained in the criteria for selecting sites. In order to meet the high hazard criteria, a site had either to rank high in a risk matrix that considers slope steepness, soil erodibility, and type of operation, or to be in a riparian zone. Table 1 shows the percent of audited sites that met the high hazard criteria, whether included by matrix, riparian, or both. Just over three-quarters of the total sites audited were high hazard. Seven of the 38 audit sites in 1988 met the high hazard criteria. The State ownership group was slightly below the two-thirds target, evaluating three high hazard sites of the five sites in this group.

Table 1

Percent of Sites Meeting High Hazard Criteria

Ownership Group	Number of Sites	Matrix	Riparian	Matrix, Riparian or both
Federal	16	48%	69%	75%
Industrial	16	44%	81%	81%
NIP	7	29%	57%	71%
State	5	40%	60%	60%
All Sites	44	39%	71%	77%

Members of all the ownership groups provided excellent cooperation as DSL selected sites. Industry and government supplied all information requested, and in most cases, in a very timely manner. DSL acquired the information about recent timber sales as follows: The affected National Forests and the BLM searched their recent timber sales for sites that met some or all of the criteria. DSL finished refining the search where needed. For non-industrial and industrial private lands, DSL searched Hazard Reduction Agreements and Master Hazard Reduction Agreements for sites that met the criteria. DSL searched its own timber sale accounting program for sites that met the criteria.

DSL randomly listed all the sites that met the criteria, by region within ownership groups. Using the risk matrix, DSL estimated the hazard rating in order to meet the site selection criteria. Because 52 sites were audited in the Flathead River Basin in 1989, the work group chose only one site there for the 1990 audit. Sites to be audited were randomly selected from the pool of suitable sites within each ownership group.

In the case of non-industrial private lands, DSL contacted the landowners for permission to visit their lands. No one denied the audit teams access. This is in stark contrast to earlier audits, where many owners denied access to their sites. Only the non-industrial private sites were field-checked before the audit--information about timber harvest location and methods on those sites was not precise enough to decide if they met the selection criteria without a field visit.

Although they may have been harvested during 1990, all of the harvest operations audited on private land started before January 1, 1990. Therefore, none of the sites audited were subject to the notification and information requirements of H.B. 678, passed by the 1989 legislature. The 1990 audits in no way evaluate the benefits of H.B. 678. Under H.B. 678, landowners and loggers receive information about BMPs and an on-site consultation for proposed operations in sensitive areas. H.B. 678 has also spawned new BMP education. Further evaluation will be required to measure the benefits of H.B. 678.

Sample Size

Because the total number of cutting units in the State is not known, it is not possible to say what percentage of them the 44 sites represent. The percentage probably isn't big enough to be statistically significant. However, it is a representative sample of logging operations conducted in Montana since 1988 that meet the selection criteria. The selection criteria limited the sample to only those timber harvest sites most sensitive to the practices that affect water quality.

The total volume of timber harvested in Montana, by ownership group, and the volume harvested from the sites that were audited, are known. See Table 2 to compare volumes harvested and volumes audited. It is likely that approximately 10% of the volume met the selection criteria and, by extrapolating, that 10% of all timber harvest sites met the selection criteria.

Table 2

Volumes Harvested and Audited by Ownership Group

	Federal	State	Industrial Private	Non-Industrial Private	Total
Total Volume (MMBF) Cut 1988-89	1092	85	896	352	2425
Volume (MMBF) of 1990 Audit Sites	7.5	2.8	16.6	3.0	30.0
Percent of Total Volume Audited	0.7%	3.3%	1.9%	0.8%	1.2%

Volume figures are in million board feet
Volume figures for federal are fiscal year; others, calendar
Figures for private land are from HRA & MHRA reports

The high percentages for the State are the result of having to audit five sites minimum, regardless of volume harvested. The percentage audited for industrial private is high because their harvest units are generally larger.

The Rating Form

The audit teams used a rating form similar to that of previous audits. See Appendix D for a copy of the form. The form was revised for the 1990 BMP field audits to reflect the changes HJR-49 made to forestry BMPs. The guide for rating application was the same as used in the 1988 audit. The guide for effectiveness changed the definition for a "2" rating from major and temporary to include minor and prolonged. The audit teams evaluated a maximum of 58 practices at each site, rating application and effectiveness for each on a 5-point scale.

The audit team rated practices for BMPs by noting if the BMP, first, was applicable to the site, and then if so, whether it was applied correctly and in the proper locations. Lack of adequate application or misapplication are departures from BMPs. The rating guide for application of BMPs was:

5 - Operation exceeds requirements of BMP.
4 - Operation meets requirements of BMP.
3 - Minor departure from intent of BMP.
2 - Major departure from intent of BMP.
1 - Gross neglect of BMP.

The following description of the rating guide is adapted from Ehinger & Potts, 1990. Ratings of 5 and 4 are self-explanatory. The 3 rating, minor departure, applies to departures of small magnitude distributed over a localized area, or over a larger area where potential for impact is low. The 2 rating, major departure, applies to departures of large magnitude or BMPs being repeatedly neglected. The 1 rating, gross neglect, applies where risks to soil and water resources were obvious and yet there was no evidence indicating that operators had applied BMPs to protect these resources.

The effectiveness rating answered the question: "Has the application or misapplication of a particular forest practice increased the likelihood of, or actual occurrence of, surface sediment in the stream channels?" Lack of effectiveness results in impacts. The rating guide for effectiveness was:

5 - Improved protection of soil and water resources over pre-project condition.
4 - Adequate protection of soil and water resources.
3 - Minor and temporary impacts on soil and water resources.
2 - Major and temporary, or minor and prolonged, impacts on soil and water resources.
1 - Major and prolonged impacts on soil and water resources.

The work group defined these terms to help the audit teams use them consistently:

Adequate - small amount of material eroded; material does not reach draws, channels, or floodplain.

Minor - some material erodes and is delivered to draws but not to stream.

Major - material erodes and is delivered to stream or annual floodplain.

Temporary - impacts lasting one year or less; no more than one runoff season.

Prolonged - impacts lasting more than one year.

The work group also approved a flow chart to help the audit teams rate application and effectiveness, and, again, to keep the rating consistent. See Appendix E.

Audit Site Inspections

In June, 1990, DSL held a calibration audit for all audit team members, on the Stevensville District of the Bitterroot National Forest. The goal was to have the audit teams practice rating sites together, in order to establish a consistent method of rating that could carry through the rest of the audits. All team members and alternates met for several hours of classroom instruction on the BMP audit process, and then evaluated a harvest site in the field. The teams shared their results with the other teams, identified the discrepancies and ways to avoid them.

The field routine consisted of meeting at a central location in the morning of each audit day. Teams traveled to the audit site. On site, the team leader provided maps and audit forms. Usually a representative of the landowner briefed the team by giving background information on the silvicultural prescription, time of operation, and associated practices. Team members walked the site, reviewing potential impact areas such as roads, streams, streamside management zones (SMZs), skid trails and firelines. Teams typically spent about two hours inspecting each site.

After finishing the inspection, the team gathered to discuss the rating while still on site. The team leader was charged with leading the discussion and recording the consensus rating for each item on the rating form. Each team completed a single rating form for each site. For ratings where the team could not reach consensus, the team took a vote and recorded the rating with the most votes. The team leader noted dissenting values in the Comments section. Teams almost always reached consensus. Less than 10 individual ratings came to a vote.

Limitations of the Audit Methods (in part, adapted from Idaho DHW, 1989)

In analyzing the audit results, readers need to consider the limitations of the techniques used in the audit. The audit technique consisted of a one-time field inspection and assessment. This approach documents erosion and sedimentation problems which occur in the first or second year after harvest. This is generally the critical period for erosion associated with timber harvests. Some practices conducted during harvest cannot easily be evaluated in post-harvest audits. The assessment was based on visual appraisal of practices and impacts to surface soils and streams. The results are a snapshot-in-time of the practices and subsequent impacts. They do not necessarily reflect future impacts.

On very large sites, time did not allow the teams to review every acre of the site. Teams concentrated on areas with the greatest potential for problems.

Three teams rated the sites. Although the teams met to calibrate their ratings, there are likely still some differences in how the teams may have rated individual items. Lack of consistency is probably not a big problem, based on discussion with other teams and through overlap of team members on some audits, but it should not be overlooked.

Also, auditors may rate several practices connected with one action. In some cases, one action may result in more than one poor rating. For example, if a skidder operates extensively in the Streamside Management Zone, the practice may rate poorly under both "Adequate SMZ Maintained" and "Equipment Operation Minimized in SMZ." Even given these limitations, the BMP audit process is the best thing going to promote BMPs and encourage landowners and operators to protect water quality on managed forests.

RESULTS

The results of the 1990 BMP field audits are presented in several categories, including application of BMPs, effectiveness of BMPs, supplemental questions on the audit form, and comparison of the 1990 results with previous audit results.

There are several ways to analyze and summarize the qualitative data generated by this study. One method is simply to look at what percent of the practices audited for BMPs fell into each rating category, by ownership group. This information is presented, for application and effectiveness of BMPs respectively, in Tables 3 and 6. While this is useful information for some purposes--including documenting problem BMP areas and comparing these results with other audits--readers should not base their conclusions on these simple percentage ratings. Appendix G tabulates how the ownership groups complied with each BMP.

All the practices evaluated in the audits can have an effect on water quality, but vary greatly in their potential impact. For example, BMPs in the "Road Planning and Location" section do not have as direct a potential impact on water quality as the practices in "Providing Adequate Road Surface Drainage" or "Adequate SMZ Maintained."

Focusing on the simple percentages will not give a clear picture of how well or poorly Montana's watersheds are being protected. Even a low percentage of misapplied BMPs can still result in serious impacts. To provide several perspectives, the data has been analyzed in different ways. In particular, a subset of nine high risk BMPs has been analyzed separately. These nine high risk BMPs are among the most important for protecting Montana's watersheds, which were chosen by the author before analyzing the data. The nine high risk BMPs are:

I.C.1	Provide adequate road surface drainage.
I.C.6	Route road drainage through SMZ.
I.D.2	Stabilize erodible soils.

I.E.2	Erosion control features functional.
II.A.5	Skid trail design avoids concentrating runoff.
II.B.1	Adequate SMZ maintained.
III.C.3	Prevent erosion of culvert and bridge fills.
II.C.2a	Adequate drainage for temporary roads, skid trails, fire lines.
II.D.9	Limit water quality impacts of prescribed fire.

The results for application and effectiveness of the nine high risk BMPs is presented in Tables 4 and 7, and Figure 1. Tables 5 and 8 summarize the data on a site basis, displaying the percent of sites with departures or impacts and the average number of departures or impacts per site.

Practices not rated

The number of practices rated represents 70% of the total possible number of practices. Some BMPs did not apply to a site: some sites did not have stream crossings; most sites did not have borrow pits; in several instances, slash disposal and site preparation had not been completed; the Hazardous Substances section of BMPs does not apply on most sites. In other cases, the audit team could not rate the BMP at the time of the audit--BMPs having to do with timing of operations during the harvest cannot be judged post-harvest.

Application of BMPs

The application rating measures whether the BMP was applied, whether it was applied correctly, and whether it was applied in the proper locations. See page 15 for further explanation of the application rating. The audit teams evaluated a total of 1780 practices to assess how landowners and operators applied BMPs. Table 3 lists the percent of practices that fell in each rating category, by ownership group. Rather than focusing on simple analysis, the reader should refer to other tables (Tables 4, 5, 7 and 8) that better indicate how well Montana's watersheds are being protected.

Table 3

Application of BMPs to All Rated Practices
by Ownership Group and Rating Category

		Percent (%) Practices Rated As			
Ownership Group	# Practices Rated	Meet or exceed	Minor departures	Major departures	Gross neglect
Federal	617	86%	11%	2%	0%
Industrial	670	78%	15%	5%	0%
NIP	294	61%	15%	17%	8%
State	199	81%	14%	5%	0%
All Sites	1780	78%	14%	6%	2%

Table 4 shows the BMP application for the nine high risk BMPs that were evaluated separately (see page 17). Fewer high risk BMPs meet or exceed their BMP requirements than the general body of practices does. The percent of practices with departures is higher for the high risk group (Table 4) than for all audited practices (Table 3), as shown in Figure 1.

Table 4

Application of High Risk BMPs
by Ownership Group and Rating Category

		Percent (%) Practices Rated As			
Ownership Group	# Practices Audited	Meet or exceed	Minor departures	Major departures	Gross neglect
Federal	117	64%	28%	8%	0%
Industrial	121	54%	31%	12%	2%
NIP	51	26%	24%	35%	16%
State	38	55%	29%	16%	0%
All Sites	327	53%	29%	15%	3%

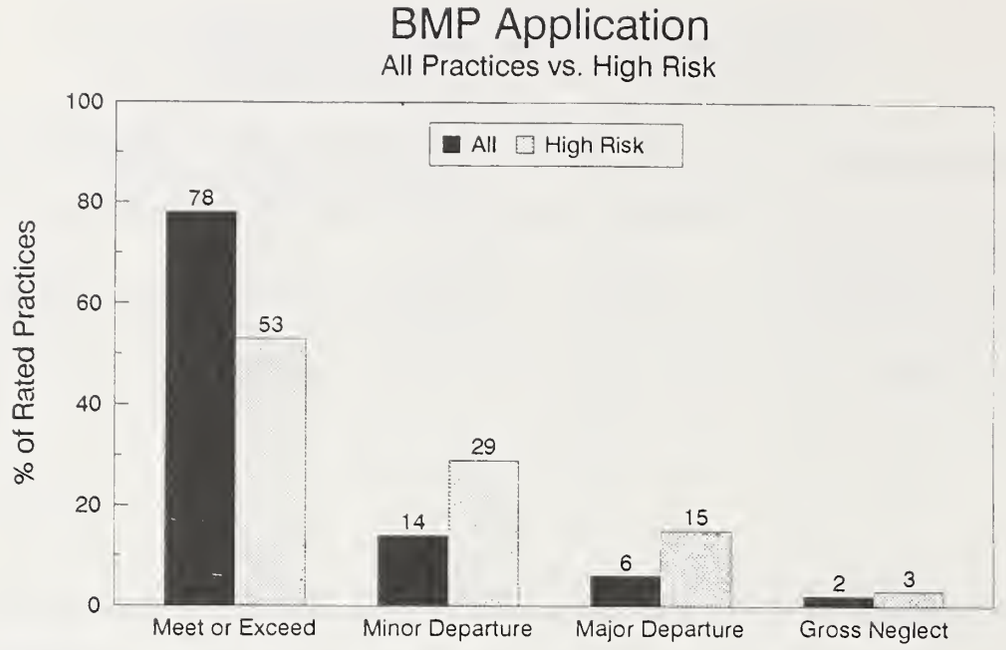


Figure 1.

Another approach is to evaluate what percentage of sites departed from BMPs, and the average number of departures per site. The average number of departures per site averages over all the sites, not just the sites with departures. Table 5 shows that nearly all sites--43 of 44--had at least one minor departure. It also shows that 27 of 44 sites have at least one major departure in BMP application. Non-industrial private lands exhibited the highest average number of departures per site.

Table 5

Audit Sites with Departures from BMP Application
and Average Number of Departures per Site

		Percent (%) of sites with departures			# of departures/total # of sites = ave. #/site		
Ownership Group	Total # of sites	Minor	Major	Gross	Minor	Major	Gross
Federal	16	94%	56%	0%	4.2	0.9	0.0
Industrial	16	100%	63%	13%	6.4	2.0	0.0
NIP	7	100%	86%	57%	6.4	7.0	3.3
State	5	100%	40%	20%	5.4	2.0	0.2
All Sites	44	98%	61%	16%	5.5	2.5	0.7

Effectiveness of BMPs

The effectiveness rating evaluates how well BMPs protected soil and water resources. See page 15 for further explanation of the effectiveness rating. The audit teams evaluated a total of 1778[1] practices to see how effective the BMPs were. Table 6 provides a summary of the effectiveness of all practices audited, by ownership group.

As with the corresponding table for BMP application (Table 3), this information should be used with discretion. While simple percentage ratings may be relatively high for the category Adequate Protection, poor effectiveness of a single BMP may still result in impacts.

Table 6

Effectiveness of BMPs for All Rated Practices
by Ownership Group and Rating Category

		Percent (%) Practices Rated As			
Ownership Group	Number of Practices Rated	Adequate Protection	Minor/Temp Impacts	Major/Temp, Minor/ Prolong	Major/ Prolong
Federal	616	89%	7%	3%	1%
Industrial	669	79%	11%	7%	3%
NIP	294	65%	17%	16%	2%
State	199	83%	10%	7%	0%
All Sites	1778	80%	11%	7%	1%

[1]One of the audit teams rated two practices for application that they did not rate for effectiveness.

Figure 2 presents the percent of practices audited that are contributing to impacts by ownership group. This figure shows differences among ownership groups in effectiveness of their BMP implementation.

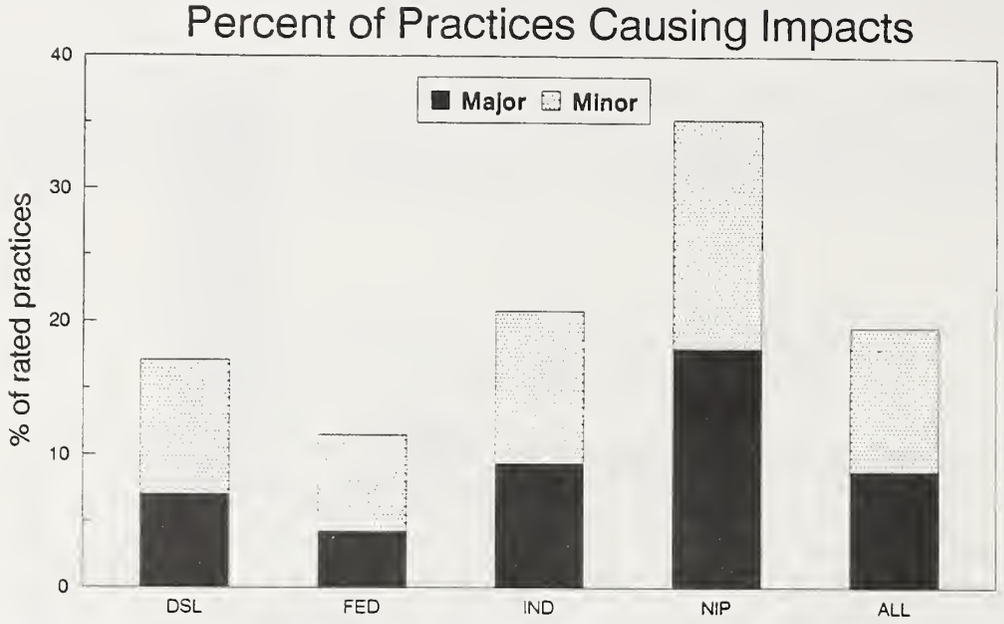


Figure 2. Major impacts are practices with an effectiveness rating < 3, minor impacts are practices with an effectiveness rating of 3.

Table 7 shows the effectiveness of the nine high risk BMPs listed on pages 17 and 18. The percent of practices providing adequate protection is lower for the high risk BMPs than for the total BMP results presented in Table 6. The percent of practices resulting in impacts is higher for the high risk BMPs than for practices in general.

Table 7

Effectiveness of High Risk BMPs
by Ownership Group and Rating Category

		Percent (%) Practices Rated As			
Ownership Group	Number of Practices Audited	Adequate Protection	Minor/Temp Impacts	Major/Temp, Minor/ Prolong	Major/ Prolong
Federal	116	69%	13%	13%	3%
Industrial	120	56%	21%	15%	8%
NIP	51	35%	21%	39%	2%
State	38	63%	18%	18%	3%
All Sites	325	58%	19%	20%	3%

Table 8 lists the percentage of sites with impacts, and average number of impacts per site. This table shows that 80% of the sites audited were producing at least minor, temporary impacts--at an average of 4.4 per site. 64% of all sites were producing major, temporary impacts--an average of 3.0 per site. This analysis illustrates that, while the percent of practices rated as providing adequate protection may be quite high (80%), impacts were still occurring on a majority of the sites audited.

Table 8

Audit Sites with Impacts and
Average Number of Impacts per Site

		Percent (%) of sites with impacts			# of impacts/total # of sites = ave. #/site		
Ownership Group	total # of sites	Minor/ Temp	Major/Temp, Minor/ Prolong	Major/ Prolong	Minor/ Temp	Major/Temp, Minor/ Prolong	Major/ Prolong
Federal	16	69%	56%	0%	2.8	1.6	0.0
Industrial	16	88%	69%	19%	4.8	2.8	1.1
NIP	7	100%	86%	14%	7.3	6.6	1.0
State	5	60%	40%	0%	4.0	2.8	0.0
All Sites	44	80%	64%	9%	4.4	3.0	0.6

Supplemental questions

The work group added seven questions to the rating form to address EPA concerns about the adequacy of Montana's BMPs. The supplemental questions and answers to them are:

1. When roads were closed, or after use of temporary roads, were culverts or stream crossing structures removed and the stream channel reformed to its pre-road configuration?

   This question applied to only 7 of the 44 sites audited. For 5 of the 7, the crossing structures were removed and the channel reformed to its pre-road configuration.

2. What condition were temporary roads left in after their use?

   Temporary roads were water-barred, seeded with grass, or obliterated except in one instance, in which the audit team noted that the road needed to be seeded with grass.

3. Would a change in stream crossing design have prevented any observed sediment discharge problems attributable to the crossings? Explain.

   On 21 of the 44 audit sites, 48%, teams noted that, yes, a change in crossing design would have prevented or reduced sediment discharge. Recommendations include: installing slash filter windrows; adjusting the grade of the road so the crossing does not concentrate road surface runoff; installing drain dips and ditch relief culverts on crossing approaches; seeding with grass; rock armoring the inlet of the culvert; using adequate size and length culvert; and, avoiding the crossing altogether.

4. Describe the width and depth of stream(s) associated with this sale.

   The average dimensions of the stream channels on the audited sites was 4.8 feet wide and 0.8 feet deep. Stream width ranged from 1 to 25 feet. Depth ranged from 0.1 to 2.5 feet deep.

5. What length of streambank was left unshaded due to timber harvest and vegetation removal in the streamside zone?

Ownership Group	Maximum Length in feet	Average Length in feet
Federal	600	134
Industrial	500	174
NIP	50	7
State	100	24
All Sites	600	118

   The three audit teams were not given direction on what constituted "unshaded." The accuracy of these results should be considered open to debate.

6. Did ground skidding take place through any perennial streams?

   Ground skidding through a perennial stream occurred on 2 of the 44 sites audited, or 5%. In one case the stream was small, 1.5 feet wide, and skidding occurred in the winter; impacts were minor. In the other case, the stream was 20 feet wide and impacts were more substantial.

7. Did timber harvest planning include considerations for watershed condition and cumulative effects of multiple timber management activities on water yield and sediment production?

   The audit teams judged landowners to have considered cumulative effects if they had calculated at least one of the following: water yield, sediment yield, or the total amount of timber harvest that had occurred in the basin, compared to the size of the basin. On three sites, the audit teams did not have enough information to judge whether cumulative effects had been considered or not.

Ownership Group	Sites Where Landowners Calculated Cumulative Effects
Federal	13 of 14 = 93%
Industrial	3 of 15 = 20%
NIP	1 of 7 = 14%
State	5 of 5 = 100%
All Sites	20 of 41 = 48% (3 sites - insufficient information)

DISCUSSION

Simple analysis, as in Table 3, indicates that 78% of the practices applied on all sites meet or exceed BMP standards. For reasons previously stated, this type of analysis does not accurately represent the impact that practices have had on the audited sites. Looking at the high risk BMPs separately, as listed in Table 4, 53% meet BMP requirements. 42% of the high risk BMPs resulted in impacts, as shown in Table 7. Another method of analysis, as documented in Table 8, indicates that 80% of the audited sites produced minor, temporary impacts and 64% produced either major, temporary or minor, prolonged impacts. Nine percent produced major, prolonged impacts. Most of these impacts could have been prevented if landowners and operators had properly applied BMPs.

The greatest departure from BMPs and the most impacts were associated with roads, primarily road drainage and secondarily road construction. On the 44 sites evaluated, road drainage BMPs were applied adequately to 50% of the practices audited. 44% of the road drainage practices rated were not effective enough to rate adequate protection, and resulted in impacts.

The list that follows is of individual BMPs that most often are not properly applied or result in impacts, ranked in order, by the sum of departures and impacts, from 45 to 17.

1. Provide adequate road surface drainage (IC1)
2. Prevent erosion of culvert and bridge fill (IIIC3)
3. Route road surface drainage through an SMZ (IC6)
4. Stabilize erodible soils (seeding) (ID2)
5. Install slash filter windrows (ID3)
6. Adequate drainage for temporary roads, skid trails, and fire lines (IIC2a)
7. Streams free of logging debris (IIB4)
8. Minimize equipment operation in SMZ (IIB3a)
9. Skid trail design avoids concentrating runoff (IIA5)
10. Erosion control features (ditches and culverts) functional (IE2)
11. Adequate SMZ maintained (IIB1)
12. Avoid equipment operations in wetlands (IIB3b)
13. Minimize compaction and displacement of soil (IID5)
14. Culverts conform to natural streambed and slope (IIIC2)
15. Grade roads to maintain drainage (IE1)
16. Limit water quality impacts of prescribed fire (IID9)

17. Vary road grade for drainage (IB4)
18. Skidding operation minimizes soil displacement (IIC1a)
19. Adjust road grades to reduce concentration of water (IIIB1b)

These 19 practices accounted for 70% of all departures and 81% of all impacts. The remaining 39 BMPs had a lower frequency of departures in application or resultant impacts.

On the positive side, BMPs that were nearly always properly applied, resulting in little or few (5 or less) impacts, include:

- Most BMPs related to road planning and location (IA)
- Design roads to minimum standard necessary (IB2)
- Skew ditch relief culverts (IC2)
- Reconstruct only to the extent necessary (ID10)
- Avoid cutting the toe of cut slopes (IE3)
- Leave abandoned roads in condition to provide adequate drainage (IE8)
- Use suitable logging system for topography (IIA2)
- Keep openings under 600 feet along channel (IIB2c)
- Get proper permits for stream crossings (IIIA1)
- Cross streams at right angles if practical (IIIB1a)
- Minimize stream channel disturbance (IIIC1)

Slash disposal and site preparation were the source of a substantial number of impacts, primarily minor impacts to the soil. On some sites, dozer operations to dispose of slash resulted in impacts greater than from the logging itself. Some team members noted that, when it comes to displacing or compacting soils, real or perceived requirements in the State hazard reduction (slash disposal) law may not always be consistent with the intent of BMPs. DSL has recently revised the guidelines for hazard reduction law. These revisions may allow alternative, lower impact methods for disposing of slash in SMZs and other areas of concern. Soil is also often displaced or compacted in an effort to meet silvicultural objectives for reforestation, rather than in effort to reduce slash.

Streamside Management Zones

Audit teams collected information on the number of stream crossings on the sites and the width of the Streamside Management Zone delineated for the harvest site. Where a range of values was given for SMZ width, the mean value was used.

Table 9

Number of Stream Crossings and Width of SMZs on Audited Sites

Ownership Group	# of Stream Crossings			Width of SMZs in feet		
	Min.	Max.	Ave.	Min.	Max.	Ave.
Federal	0	4	1.4	0	100	36
Industrial	0	5	2.1	25	112	52
NIP	0	4	1.4	18	40	29
State	0	2	1.2	20	75	51
All Sites	0	5	1.7	0	112	43

Table 10 shows the effectiveness of BMPs applied in the SMZ with respect to the width of the SMZ. Wider SMZs resulted in fewer impacts from harvest practices within the SMZ.

Table 10

Effectiveness of SMZ-BMPs by SMZ Width

SMZ Width	Percent (%) Rated As			
	Adequate Protection	Minor/Temp	Major/Temp, Minor/Prolong	Major/Prolong
< 25 ft.	76%	11%	13%	0%
25-50 ft.	85%	9%	6%	1%
> 50 ft.	91%	9%	0%	0%
Overall	85%	9%	6%	0.3%

Results by Ownership Group

There are notable differences among the ownership groups in their application and effectiveness of all BMPs. Federal lands consistently rated better than the other ownership groups. Federal (USFS and BLM) standards of operation generally exceed the minimum BMP requirements.

The Department of State Lands ranked second among the ownership groups for application and effectiveness of BMPs. Industrial private owners ranked third, and non-industrial private ranked fourth. All sites on non-industrial private lands had minor, temporary impacts; all but one had major or prolonged impacts (an effectiveness rating less than 3.)

There appears to be no notable differences among regions of the State in application and effectiveness of BMPs.

Comparison with previous audits

The 1990 audits generally resulted in ratings lower than those of previous audits. Evidence for this is presented in Figures 3, 4, 5 and 6. 1990 ratings are lower than the Flathead Basin Audits. 1990 audit ratings are only slightly lower than the 1988 EQC audits, when compared by overall percentage ratings (Figures 3 and 4).

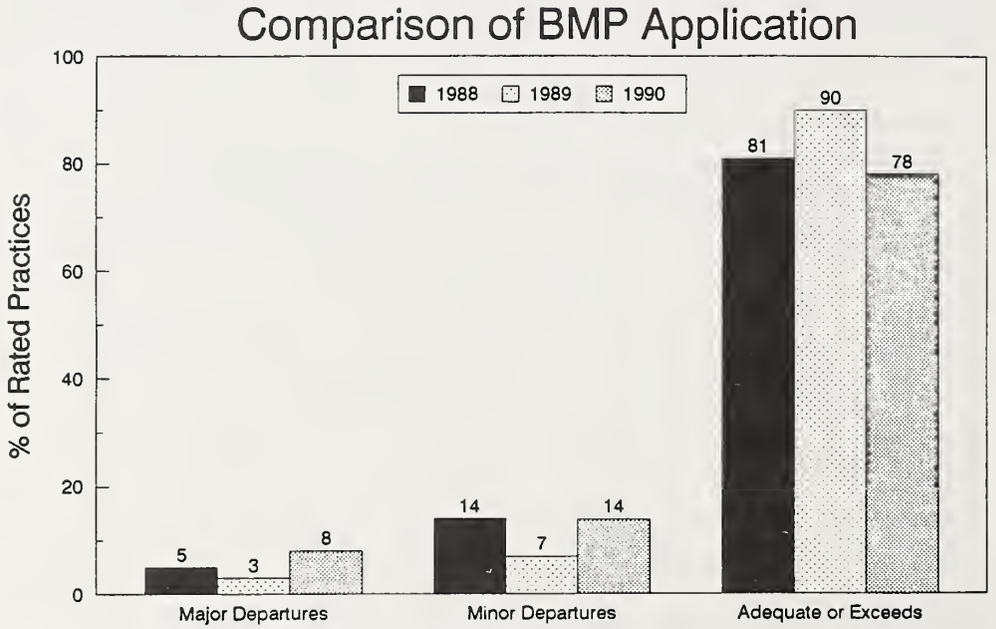


Figure 3. Major departures are practices with an application rating < 3, minor departures are practices with an application rating of 3. Adequate or exceeds are practices with an application rating > 3.

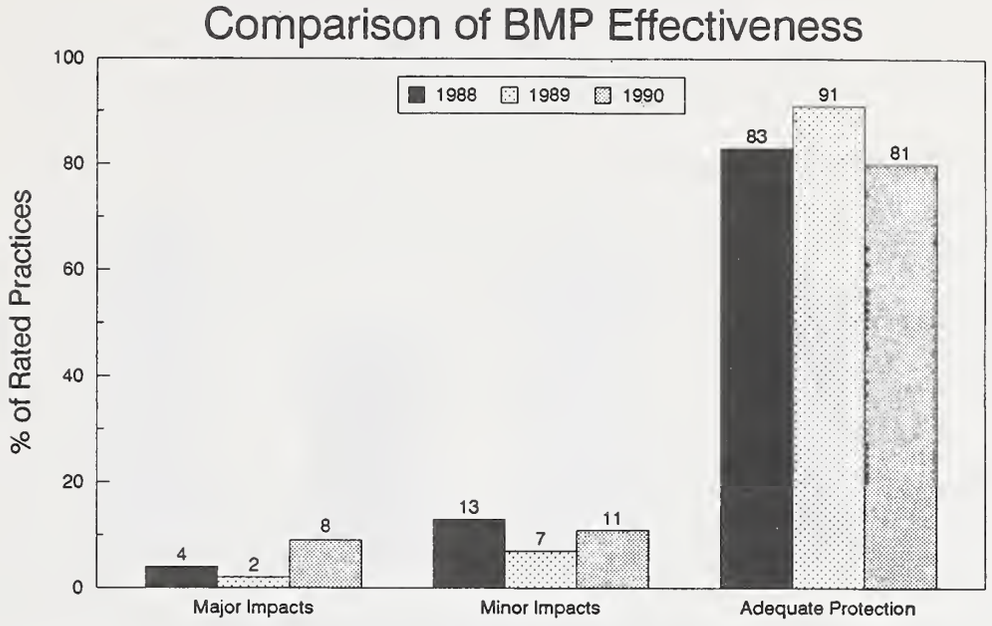


Figure 4. Major impacts are practices with an effectiveness rating < 3, minor impacts are practices with an effectiveness rating of 3. Adequate protection is a practice with an effectiveness rating > 3.

There are several possible reasons for the differences in the ratings among audits that may offer further understanding of the lower ratings:

- The 1990 audits met the high hazard criteria and therefore looked at more sites with potential problems than other years had.
- More sites with new roads were evaluated due to a change in the selection criteria. New roads are usually the main source of sediment from timber harvest sites.
- Definitions were added to the effectiveness rating. These definitions had not existed for previous audits.
- Team members had a clearer definition of a "stream," and therefore a better idea of where SMZ BMPs applied.
- Climactic differences. The drought that occurred in 1988 may have made it hard to judge impacts. Runoff conditions have been closer to average for the 1990 audits.
- For consistency, the work group approved a rationale flow chart that the teams used to decide ratings on site. See Appendix E.
- More practices were evaluated. The form was revised to include additional BMPs.

The 1990 audit ratings are substantially lower than the 1988 ratings when one looks at sites with major departures or impacts, as in Figure 5.

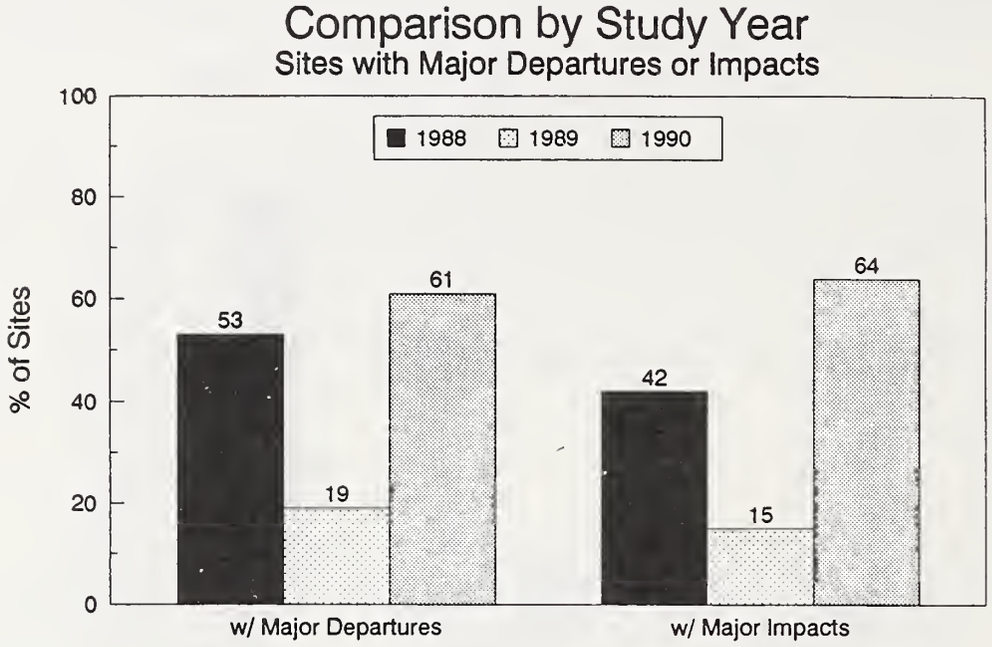


Figure 5. Major departures are practices with an application rating of 1 or 2. Major impacts are practices with an effectiveness rating of 1 or 2.

The 1990 audits had a greater number of major impacts per site than earlier audits did. See Figure 6. Impacts per site are expressed as a percentage of rated practices per site, in order to account for differences in the average number of rated practices per site between study years.

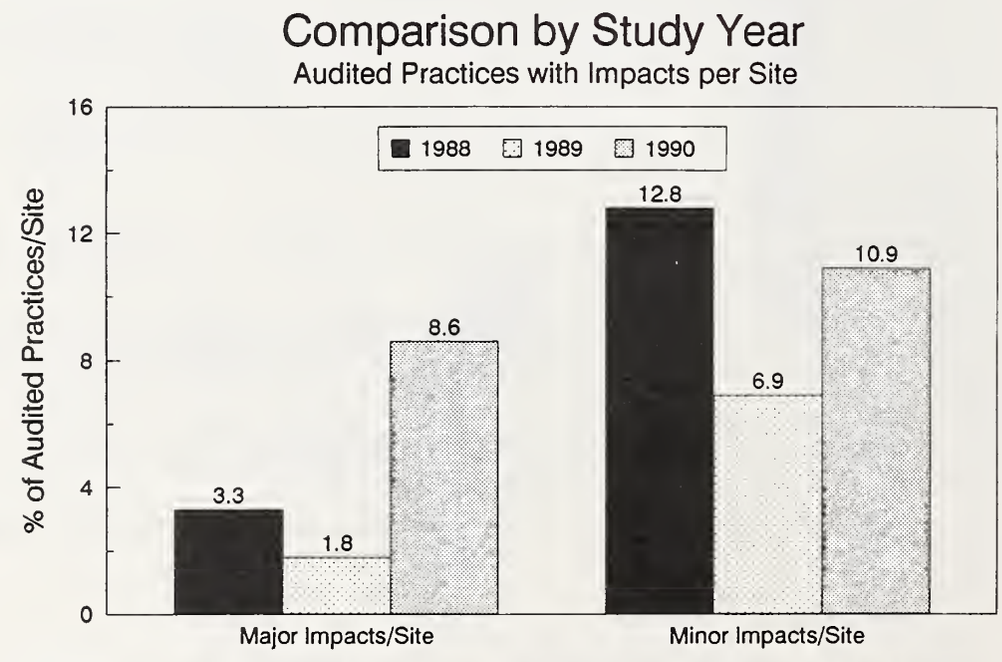


Figure 6. Major Impacts are pratices with an effectiveness rating of < 3. Minor Impacts are practices with an effectiveness rating of 3.

RECOMMENDATIONS

- Continue the interdisciplinary BMP audits, whether under a non-regulatory or regulatory program. The audit process has been fundamental in educating and making people aware of BMP requirements.
- Two-thirds of the audit team and work group members attending the October 10, 1990 post-audit meeting recommend that the audits be conducted on an annual basis for several years, in order to make landowners and timber operators more aware of forestry BMPs. The rest of the members present felt that conducting the audits every two years would suffice.
- Form a committee to study and rectify perceived inconsistencies of the hazard reduction requirements, BMP goals and silvicultural objectives for reforestation.
- Adjust BMPs where the audits point out weaknesses. Use the notes that resulted from the 1990 audits; DSL has kept these notes.
- Continue educating loggers, landowners, and foresters, concentrating on problem areas documented through BMP audits.
- Keep future audits consistent with past audits to provide a relevant means of comparison.
- Actively encourage the sites' logging contractors to attend the audit. At a minimum, give contractors a copy of the audit results for their sites.
- Develop a system to remedy specific problems found during audits.
- Continue funding volunteer audit team members.

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Ehinger W. and D. Potts. 1990. On-Site Assessment of "Best Management Practices as an Indicator of Cumulative Watershed Effects in the Flathead Basin." Flathead Basin Water Quality and Fisheries Cooperative. University of Montana School of Forestry. Missoula, Montana 137 pp.

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APPENDIX A

3/5/90

DSL-FORESTRY DIVISION
1990 BMP FIELD AUDITS

WORK GROUP MEMBERS

NAME	LOCATION	EXPERTISE	AFFILIATION
Don Alley	Kalispell	Fisheries	Trout Unlimited
Rod Ash	Condon	Flathead Audits	Flathead Audubon
Loren Bahls	Helena	Water Quality	Water Quality Bureau
Jim Bentley	Missoula	Forestry	Champion Timberlands
Vito Ciliberti	Missoula	Hydrology\Soils	Bureau of Land Management
Bud Clinch	Kalispell	Forestry	Montana Logging Association
Rep. Barton Cooper	Boulder	Logging\Rd. Const.	Contractor
Bill Ehinger	Missoula	Hydrology	M.S. Student-- U. of M.
Bruce Farling	Missoula	Water Res.	Clark Fork Coalition
Bill Gwynn	Eureka	Logging	Forest Landowner
Pam Hackley	Helena	Soils	Montana Environmental Information Center
Michael Lyngholm	Dillon	Forestry\Logging	East Side Forest Practices Committee/ Stoltze
Glen Phillips	Helena	Fisheries\WQ	Dept. Fish, Wildlife, & Parks
Bill Putnam	Missoula	Hydrology	U.S. Forest Service
Bill Schultz	Missoula	Hydrology	Dept. of State Lands
Denny Sigars	Missoula	Forestry	Plum Creek Timber Co.

APPENDIX B

6/4/90

1990 BMP FIELD AUDITS

BMP AUDIT TEAM MEMBERS

EXPERTISE	AUDIT TEAM		
	NORTHWEST	**WEST CENTRAL**	**SOUTHWEST/EAST**
Fisheries	+S. Rumsey, DFWP (+T. Weaver, DFWP)	D. Workman, DFWP (C. Clancey, DFWP)	+G. Phillips, DFWP (J. Brammer, DWFP)
Hydrology	+B. Putnam, USFS (J. Schumaker, DNRC)	+B. Schultz, DSL (G. Frank, DSL)	+S. Tralles, WQB (+K. Sutherland)
Soils	+J. Collins, DSL (+K. McKlintock, WI)	B. Dutton, PVT (T. Wiersum, SCS)	+V. Ciliberti, BLM (M. Browne, BLM)
Forestry	R. Hudson, PVT (F. McCubbins, Stoltze)	+G. Sanders, CIC (P. Davis, PCTC)	M. Lyngholm, ESFP (B. Hayes, Consul.)
Eng./ Roads	J. Okonski, Consul. (V. Anderson, PCTC)	+Joel Marshik, USFS (T. Colter, LP)	D. Wick, PCTC (S. Anderson, Cont.)
Conservation	+Don Alley, TU (+R. Ash, Audub.)	B. Benson, CFC (B. Farling, CFC)	+P. Hackley, EIC (C. Jones, EIC)

Legend:

UNDERLINE denotes Team Leader

( ) denotes alternate

+ denotes prior BMP audit team experience

1990 BMP FIELD AUDITS
RISK RATING GUIDE

MONTANA "RISK" MATRIX (8/90)

TYPE		CLEARCUT				PARTIAL CUT				SITE PREP			ROADS	
SLOPE	SOIL EROD.	TRACKED EQUIP.	RUBBER SKID	PARTIAL SUSP.	FULL SUSP.	TRACKED EQUIP.	RUBBER SKID	PARTIAL SUSP.	FULL SUSP.	MACHINE PILE/SCAR	BRDCAST BURN	OTHER	PERM.	TEMP.
0-5%	H	2	2	2	1	2	2	1	1	2	1	1	2	3
	M	2	1	1	2	2	1	1	1	2	1	1	1	1
	L	1	1	1	1	1	1	1	1	1	1	1	1	1
5-20%	H	4	3	2	1	4*	3	2	1	4	2	1	3	4
	M	3	2	1	1	3*	2	1	1	3	2	1	2	3
	L	2	2	1	1	2*	2*	1	1	2	1	1	2	2
20-40%	H	5	5	4*	2	5*	5*	4*	1	5	4*	1	4	5
	M	4*	4	3	1	3	3	2	1	4	3	1	3	4*
	L	3*	2	2	1	2	2	2	1	3	2	1	3*	3
> 40%	H	5	5	4	2	5	5	4	2	5	4	1	5	5
	M	5	5	4	2*	5	5	3	1	5	4	1	5	5
	L	4	4	3	1	4	4	2	1	4	3*	1	4	4

MONTANA EROSION-IMPACT MATRIX
(* Indicates Mean Value Used)

From: Montana Riparian Association
Watershed Risk Assessment - 1990

LEGEND

1 = LOW RISK
2-3 = MODERATE RISK
4-5 = HIGH RISK

SOIL ERODIBILITY

HIGH ERODIBILITY	MODERATE ERODIBILITY	LOW ERODIBILITY
GRANITICS	SCHIST	
ALLUVIUM	SOFT/HARD SEDIMENTS	METAMORPHIC (BELT)
LACUSTRINE	BASIC IGNEOUS	ABRILLITE/ QUARTZITE

HIGH RISK DUE TO RIPARIAN HARVEST

"HIGH" risk will be assigned to sales with logging in riparian zones along streams. Riparian zones are located between aquatic and terrestrial environments and are identified by distinct vegetation that requires or tolerates free or unbound water. This includes, but is not limited to, the following habitat types: ABLA/CACA (all phases), ABLA/OPHO, PICEA/EQAR, THPL/OPHO.

MONTANA FOREST PRACTICES REVIEW WORKSHEET

DATE: _____ OWNER: _____

HRA #: _____ CONTRACTOR: _____

LEGAL DESCRIPTION: _____

DRAINAGE: _____

SALE NAME: _____

GEOLOGY & SOILS: _____

_____

SLOPE RANGE: _____

PRACTICES

STAGE: (X IF COMPLETED) PREHARVEST ( ) ROAD CONSTRUCTION ( )
HARVEST ( ) SLASH DISPOSAL ( )

ROADS: NEW CONSTRUCTION (LENGTH): _____

RECONSTRUCTION (LENGTH): _____

HARVEST: CLEARCUT _____ SEEDTREE _____
(ACRES & METHOD) OSR _____ SHELTERWOOD _____

IND. SELECTION _____

SITE PREPARATION: _____

SLASH DISPOSAL: _____

RATING GUIDE

APPLICATION
5--OPERATION EXCEEDS REQUIREMENTS OF BMP
4--OPERATION MEETS REQUIREMENTS OF BMP
3--MINOR DEPARTURE FROM BMP
2--MAJOR DEPARTURE FROM BMP
1--GROSS NEGLECT OF BMP

EFFECTIVENESS
5--IMPROVED PROTECTION OF SOIL AND WATER RESOURCES OVER PRE-PROJECT CONDITION
4--ADEQUATE PROTECTION OF SOIL AND WATER RESOURCES
3--MINOR AND TEMPORARY IMPACTS ON SOIL & WATER RESOURCES
2--MAJOR AND TEMPORARY OR MINOR AND PROLONGED IMPACTS ON SOIL AND WATER RESOURCES.
1--MAJOR AND PROLONGED IMPACTS ON SOIL AND WATER RESOURCES.

DEFINITIONS (BY EXAMPLE):
ADEQUATE--SMALL AMOUNT OF MATERIAL ERODED; MATERIAL DOES NOT REACH DRAWS, CHANNELS, OR FLOODPLAIN.
MINOR--EROSION AND DELIVERY OF MATERIAL TO DRAWS BUT NOT STREAM.
MAJOR--EROSION AND SUBSEQUENT DELIVERY OF SEDIMENT TO STREAM OR ANNUAL FLOODPLAIN.
TEMPORARY--IMPACTS LASTING ONE YEAR OR LESS; NO MORE THAN ONE RUNOFF SEASON.
PROLONGED--IMPACTS LASTING MORE THAN ONE YEAR.

NR--NOT REVIEWED
NA--NOT APPLICABLE

RECOMMENDED BEST MANAGEMENT PRACTICES	APPLICABLE TO SITE (Y/N) APPLICATION	EFFECTIVENESS	COMMENTS
ROADS			
ROAD PLANNING & LOCATION--SECTION I.A.			
1a. MINIMIZE NUMBER OF ROADS NECESSARY.			
1b. USE EXISTING ROADS UNLESS AGGRAVATE EROSION.			
3a. FIT ROAD TO THE TOPOGRAPHY.			
3b. AVOID LONG, SUSTAINED, STEEP ROAD GRADES.			
4. LOCATIONS AVOID HIGH HAZARD SITES.			
5. ADEQUATE SMZ BETWEEN ROAD AND STREAM CHANNELS.			
6. MINIMIZE NUMBER OF STREAM CROSSINGS. NUMBER _____.			

I.D. _____

RECOMMENDED BEST MANAGEMENT PRACTICES	APPLICABLE TO SITE (Y/N)	APPLICATION	EFFECTIVENESS	COMMENTS
ROAD DESIGN--SECTION I.B.				
2. DESIGN ROADS TO MINIMUM STANDARD NECESSARY.				
4. VARY ROAD GRADE FOR DRAINAGE.				
5. PROPER SIZING FOR CROSSING STRUCTURES.				
DRAINAGE FROM ROAD SURFACE SECTION I.C.				
1. PROVIDE ADEQUATE ROAD SURFACE DRAINAGE.				
2. SKEW DITCH RELIEF CULVERTS.				
4. PROVIDE ENERGY DISSIPATORS AT CMP OUTLETS WHERE NEEDED.				
6. ROUTE ROAD DRAINAGE THROUGH SMZ.				
CONSTRUCTION--SECTION I.D.				
1. EROSION CONTROL WORK CURRENT WITH CONSTRUCTION.				
2. STABILIZE ERODIBLE SOILS (SEEDING).				
3. SLASH FILTER WINDROWS INSTALLED.				
5. CUT AND FILL SLOPES AT STABLE ANGLES. SLOPE RATIO: _____.				
6. CLEAR VEGETATION BEFORE CONSTRUCTION.				
8. OVERBURDEN PLACED TO AVOID ENTERING STREAM.				
9. SEDIMENT FROM BORROW PITS MINIMIZED.				
10. RECONSTRUCT ONLY TO THE EXTENT NECESSARY.				
ROAD MAINTENANCE--SECTION I.E.				
1. GRADE ROADS TO MAINTAIN DRAINAGE.				
2. EROSION CONTROL FEATURES (DITCHES AND CULVERTS) FUNCTIONAL.				
3. AVOID CUTTING THE TOE OF CUT SLOPES.				
6. RESTRICT USE OF ROADS DURING WET PERIODS AND SPRING BREAKUP.				
8. ABANDONED ROADS IN CONDITION TO PROVIDE ADEQUATE DRAINAGE.				

I.D. _____

RECOMMENDED BEST MANAGEMENT PRACTICES	APPLICABLE TO SITE (Y/N)	APPLICATION	EFFECTIVENESS	COMMENTS
TIMBER HARVESTING HARVEST DESIGN--SECTION II.A.				
2. SUITABLE LOGGING SYSTEM FOR TOPOGRAPHY.				
5. SKID TRAIL DESIGN AVOIDS CONCENTRATING RUNOFF.				
6. SUITABLE LOCATION, SIZE, AND NUMBER OF LANDINGS.				
STREAMSIDE MANAGEMENT--SECTION II.B.				
1. ADEQUATE SMZ MAINTAINED (WIDTH _____).				
2a. VEGETATION MAINTAINED ALONG STREAM.				
2b. RETAIN TREES FOR STABILIZATION.				
2c. OPENINGS UNDER 600 FT. ALONG CHANNEL.				
3a. EQUIPMENT OPERATION MINIMIZED IN SMZ.				
3b. AVOID EQUIPMENT OPERATION IN WETLANDS.				
3c. AVOID EQUIPMENT OPERATION IN STREAM CHANNELS.				
4. STREAMS FREE OF LOGGING DEBRIS.				
OTHER HARVESTING ACTIVITIES SECTION II.C.				
1a. SKIDDING OPERATION MINIMIZES SOIL DISPLACEMENT.				
1b. SKIDDING OPERATION MINIMIZES COMPACTION.				
2a. ADEQUATE DRAINAGE FOR TEMPORARY ROADS, SKID TRAILS AND FIRE LINES.				
2b. ADEQUATE DRAINAGE FOR LANDINGS.				
SLASH TREATMENT AND SITE PREPARATION SECTION II.D.				
2. BRUSH BLADES USED ON DOZERS.				
4. SCARIFY ONLY TO THE EXTENT NECESSARY.				
5. COMPACTION AND DISPLACEMENT MINIMIZED.				
6. DOZER OPERATIONS ON SUITABLE SLOPES ONLY.				
9. LIMIT WATER QUALITY IMPACT OF PRESCRIBED FIRE.				

I.D. _____

RECOMMENDED BEST MANAGEMENT PRACTICES	APPLICABLE TO SITE (Y/N) APPLICATION	EFFECTIVENESS		COMMENTS
STREAM CROSSINGS				
LEGAL REQUIREMENTS--SECTION III.A.				
1. PROPER PERMITS FOR STREAM CROSSINGS.				
DESIGN CONSIDERATIONS--SECTION III.B.				
1a. CROSS STREAMS AT RIGHT ANGLES. IF PRACTICAL.				
1b. ADJUST ROAD GRADES TO REDUCE CONCENTRATION OF WATER.				
2. AVOID UNIMPROVED STREAM CROSSINGS.				
INSTALLATION OF STREAM CROSSINGS SECTION III.C.				
1. MINIMIZE STREAM CHANNEL DISTURBANCE.				
2. CULVERTS CONFORM TO NATURAL STREAMBED AND SLOPE.				
3. PREVENT EROSION OF CULVERT AND BRIDGE FILLS.				
5. MINIMUM COVER FOR CULVERTS PROVIDED.				
HAZARDOUS SUBSTANCES GENERAL--SECTION V.A.				
1. COMPLY WITH REGULATION ON STORAGE, HANDLING, APPLICATION, AND DISPOSAL OF HAZARDOUS SUBSTANCES.				
2. ADEQUATE STORAGE AND DISPOSAL FOR FUEL, SHOP DEBRIS, AND WASTE OIL.				
PESTICIDES AND HERBICIDES SECTION V.B.				
1. PREVENT ENTRY OF HAZARDOUS SUBSTANCES INTO SURFACE WATERS.				
OTHER				**ADDITIONAL COMMENTS**

I.D. _____

SUPPLEMENTAL QUESTIONS
1990 BMP AUDITS

1. When roads were closed, or after use of temporary roads, were culverts or stream crossing structures removed and stream channel reformed to its pre-road configuration? (EPA #7A.)

2. What condition were temporary roads left in after their use? (EPA #7B.)

3. Would a change in stream crossing design have prevented any observed sediment discharge problems attributable to the crossings? Explain. (EPA #9A.)

4. Describe the width and depth of stream(s) associated with this sale. (EPA #12B.)

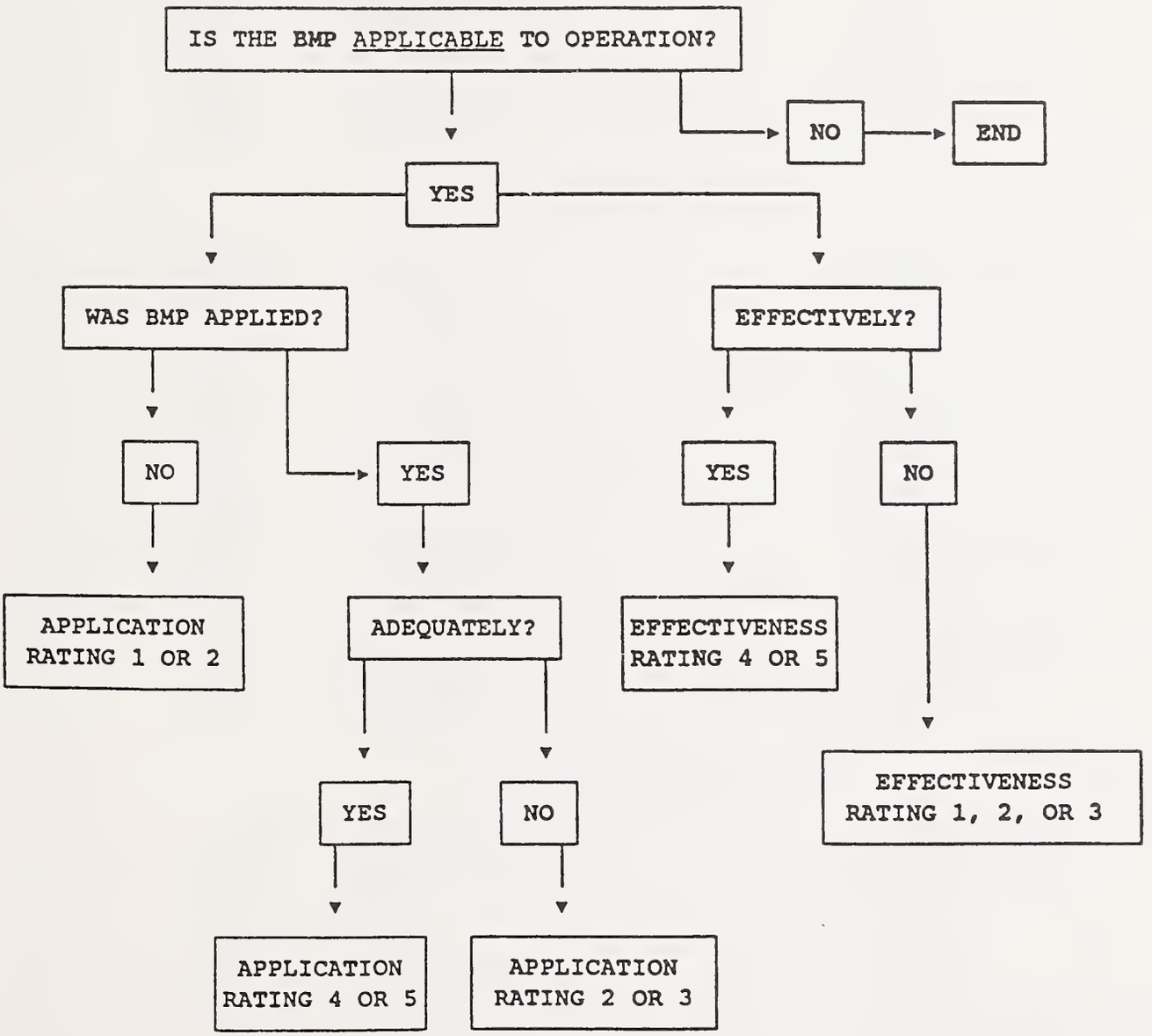
5. What length of streambank was left unshaded due to timber harvest and vegetation removal in the streamside zone? (EPA #13B.)

6. Did ground skidding take place through any perennial streams? (EPA #15A.)

7. Did timber harvest planning include considerations for watershed condition and cumulative effects of multiple timber management activities on water yield and sediment production? (EPA #21A.)

RATIONALE FOR THE RATING SYSTEM

POST HARVEST EVALUATION



APPENDIX F
1990 FORESTRY BMP FIELD AUDITS SCHEDULE

NORTHWEST TEAM

DATE	AUDIT #	SALE NAME	OWNER GROUP
July 17	FED-12	Yarnell-Cripple Horse	Federal
July 17	DSL-4	Poker-Smoke	State
July 18	IND-12	S.W. Haskill	Industrial
July 18	IND-13	Wooster Gwavy	Industrial
July 24	DSL-3	Trout Creek	State
July 24	FED-11	S.W. Pilgrim	Federal
July 25	IND-3	Lake Creek Jammer	Industrial
July 25	IND-4	Keeler Progeny	Industrial
Aug. 15	FED-7	Clingback Pest Control	Federal
Aug. 15	FED-8	North Parsnip	Federal
Aug. 16	FED-9	Prospect Creek	Federal
Aug. 21	FED-10	Horse Cable	Federal
Aug. 21	NIP-2	Pleasant Valley Fisher River	Non-Industrial Pvt.
Aug. 22	IND-5	Lower Barnum	Industrial
Aug. 22	FED-13	Squaw Salvage	Federal

WEST CENTRAL TEAM

DATE	AUDIT #	SALE NAME	OWNER GROUP
July 19	FED-4	Bugle	Federal
July 19	FED-5	East Piquett	Federal
July 20	IND-8	Tyler Cats	Industrial
July 20	DSL-5	Dry Secret	State
Aug. 2	IND-10	Chamberlain	Industrial
Aug. 2	FED-1	Skimmerhorn	Federal
Aug. 3	IND-9	Liberty Divide	Industrial
Aug. 3	FED-14	Sawyer	Federal
Aug. 16	FED-15	Snowstorm	Federal
Aug. 16	NIP-7	Prospect Creek	Non-Industrial Pvt.
Aug. 17	IND-6	4-Big Hole	Industrial
Aug. 23	IND-7	Mill Tevis 2	Industrial
Aug. 23	NIP-3	Sweathouse Creek	Non-Industrial Pvt.
Aug. 24	IND-1	Rye Creek	Industrial
Aug. 24	DSL-1	Spring Hill	State

SOUTHWEST TEAM

DATE	AUDIT #	SALE NAME	OWNER GROUP
July 25	FED-2	Barton Gulch	Federal
July 25	FED-3	Gibbs	Federal
July 26	IND-14	Sweet 18	Industrial
July 26	IND-15	Mule Crossing	Industrial
Aug. 23	FED-6	Quartzite-Moose	Federal
Aug. 24	NIP-4	Mill Creek	Non-Industrial Pvt.
Aug. 24	NIP-5	Pike Creek	Non-Industrial Pvt.
Aug. 28	DSL-2	Miner Creek	State
Aug. 29	NIP-1	Twin Lakes Creek	Non-Industrial Pvt.
Aug. 29	IND-2	Mt. Haggin L.P.	Industrial
Sept. 5	NIP-6	Cataract Creek	Non-Industrial Pvt.
Sept. 5	IND-16	Sparks	Industrial
Sept. 6	IND-11	Warm Springs Divide	Industrial
Sept. 6	FED-16	Upper Willow Creek	Federal

A P P E N D I X G

BMP RATINGS BY PRACTICE AND OWNERSHIP GROUP

		APPLICATION						EFFECTIVENESS					
Practice	Owner	1	2	3	4	5	NR	1	2	3	4	5	NR
ROAD PLANNING													
Minimize # of Roads IA1a	DSL	0	0	0	5	0	0	0	0	0	5	0	0
	FED	0	0	0	13	0	3	0	0	0	13	0	3
	IND	0	0	0	15	0	1	0	0	1	14	0	1
	NIP	0	0	0	7	0	0	0	0	0	7	0	0
	Total:	0	0	0	40	0	4	0	0	1	39	0	4
Use Existing Roads IA1b	DSL	0	0	0	5	0	0	0	0	0	5	0	0
	FED	0	0	0	10	0	6	0	0	0	10	0	6
	IND	0	0	0	8	0	8	0	0	0	8	0	8
	NIP	0	0	1	4	0	2	0	0	2	3	0	2
	Total:	0	0	1	27	0	16	0	0	2	26	0	16
Fit Road to Topography IA3a	DSL	0	0	0	4	0	1	0	0	0	4	0	1
	FED	0	0	0	12	0	4	0	0	0	12	0	4
	IND	0	1	0	14	0	1	1	0	0	14	0	1
	NIP	0	0	1	5	0	1	0	0	1	5	0	1
	Total:	0	1	1	35	0	7	1	0	1	35	0	7
Avoid Long, Steep Grades IA3b	DSL	0	0	0	3	0	2	0	0	0	3	0	2
	FED	0	0	2	10	0	4	0	1	1	10	0	4
	IND	0	1	0	14	0	1	1	0	0	14	0	1
	NIP	0	1	1	4	0	1	0	1	1	4	0	1
	Total:	0	2	3	31	0	8	1	2	2	31	0	8
Avoid High Hazard Areas IA4	DSL	0	0	0	4	0	1	0	0	0	4	0	1
	FED	0	0	1	9	0	6	0	0	1	9	0	6
	IND	1	1	1	11	0	2	1	1	0	12	0	2
	NIP	0	2	1	3	0	1	0	2	1	3	0	1
	Total:	1	3	3	27	0	10	1	3	2	28	0	10
Adequate SMZ Planned IA5	DSL	0	0	0	4	0	1	0	0	0	4	0	1
	FED	0	0	1	8	0	7	0	1	0	8	0	7
	IND	0	0	1	8	0	7	0	1	1	7	0	7
	NIP	0	0	0	3	0	4	0	0	0	3	0	4
	Total:	0	0	2	23	0	19	0	2	1	22	0	19

BMP RATINGS BY PRACTICE AND OWNERSHIP GROUP

		APPLICATION						EFFECTIVENESS					
Practice	Owner	1	2	3	4	5	NR	1	2	3	4	5	NR
Minimize # of	DSL	0	0	0	5	0	0	0	0	0	5	0	0
Stream X'ings	FED	0	0	0	10	0	6	0	0	0	10	0	6
IA6	IND	0	0	1	14	0	1	0	1	0	14	0	1
	NIP	0	0	1	5	0	1	0	1	0	5	0	1
	Total:	0	0	2	34	0	8	0	2	0	34	0	8
ROAD DESIGN													
Minimum Design	DSL	0	0	0	4	0	1	0	0	0	4	0	1
Standards	FED	0	0	0	12	0	4	0	0	0	12	0	4
IB2	IND	0	0	1	14	0	1	0	0	1	14	0	1
	NIP	0	0	0	7	0	0	0	0	0	7	0	0
	Total:	0	0	1	37	0	6	0	0	1	37	0	6
Vary Grade	DSL	0	0	0	3	0	2	0	0	0	3	0	2
for Drainage	FED	0	0	2	10	0	4	0	0	3	9	0	4
IB4	IND	0	1	0	14	0	1	0	1	0	14	0	1
	NIP	1	3	1	1	0	1	0	3	2	1	0	1
	Total:	1	4	3	28	0	8	0	4	5	27	0	8
Crossings	DSL	0	0	0	4	0	1	0	0	0	4	0	1
Properly Sized	FED	0	0	0	10	0	6	0	0	0	10	0	6
IB5	IND	0	0	2	10	0	4	0	0	2	10	0	4
	NIP	1	1	0	3	0	2	1	0	1	3	0	2
	Total:	1	1	2	27	0	13	1	0	3	27	0	13
ROAD DRAINAGE													
Adequate Sur-	DSL	0	2	3	0	0	0	0	2	0	3	0	0
face Drainage	FED	0	0	6	9	0	1	0	4	2	9	0	1
IC1	IND	1	1	5	9	0	0	2	2	2	10	0	0
	NIP	3	3	1	0	0	0	0	5	1	1	0	0
	Total:	4	6	15	18	0	1	2	13	5	23	0	1
Skew Relief	DSL	0	0	0	0	0	5	0	0	0	0	0	5
Culverts	FED	0	0	0	8	0	8	0	0	0	8	0	8
IC2	IND	0	0	1	2	0	13	0	0	1	2	0	13
	NIP	0	0	0	1	0	6	0	0	0	1	0	6
	Total:	0	0	1	11	0	32	0	0	1	11	0	32

BMP RATINGS BY PRACTICE AND OWNERSHIP GROUP

		APPLICATION						EFFECTIVENESS					
Practice	Owner	1	2	3	4	5	NR	1	2	3	4	5	NR
Energy Dissip.	DSL	0	0	0	0	0	5	0	0	0	0	0	5
at CMP Outlets	FED	0	0	1	6	0	9	0	0	1	6	0	9
IC4	IND	0	1	2	2	0	11	0	1	2	2	0	11
	NIP	0	0	1	1	0	5	0	0	1	1	0	5
	Total:	0	1	4	9	0	30	0	1	4	9	0	30
Route Drainage	DSL	0	1	2	1	0	1	0	1	1	2	0	1
Through SMZ	FED	0	3	4	6	0	3	0	4	2	7	0	3
IC6	IND	1	2	6	5	0	2	3	3	3	5	0	2
	NIP	1	2	0	1	0	3	0	3	0	1	0	3
	Total:	2	8	12	13	0	9	3	11	6	15	0	9
ROAD CONSTRUCTION													
Erosion Control	DSL	0	0	0	0	0	5	0	0	0	0	0	5
Concurrent	FED	0	0	0	3	0	13	0	0	0	3	0	13
ID1	IND	1	1	0	2	0	12	1	1	0	2	0	12
	NIP	0	0	1	1	0	5	0	0	1	1	0	5
	Total:	1	1	1	6	0	35	1	1	1	6	0	35
Stabilize	DSL	0	2	0	2	0	1	0	2	1	1	0	1
Erodible Soils	FED	0	0	1	11	0	4	0	1	3	7	0	5
ID2	IND	0	2	3	9	0	2	0	1	6	6	0	3
	NIP	0	3	3	0	0	1	0	2	2	2	0	1
	Total:	0	7	7	22	0	8	0	6	12	16	0	10
Slash Filter	DSL	0	0	2	0	0	3	0	0	2	0	0	3
Windrows Used	FED	0	1	2	1	0	12	0	2	1	1	0	12
ID3	IND	0	2	6	3	0	5	1	2	6	2	0	5
	NIP	0	1	1	0	0	5	0	0	2	0	0	5
	Total:	0	4	11	4	0	25	1	4	11	3	0	25
Slopes at	DSL	0	0	0	3	0	2	0	0	0	3	0	2
Stable Angle	FED	0	0	1	12	0	3	0	0	2	11	0	3
ID5	IND	0	2	0	12	0	2	1	1	0	12	0	2
	NIP	0	0	3	3	0	1	0	0	3	3	0	1
	Total:	0	2	4	30	0	8	1	1	5	29	0	8

BMP RATINGS BY PRACTICE AND OWNERSHIP GROUP

		APPLICATION						EFFECTIVENESS					
Practice	Owner	1	2	3	4	5	NR	1	2	3	4	5	NR
Clear Veget.	DSL	0	0	0	3	0	2	0	0	0	3	0	2
Before Const.	FED	0	0	0	11	0	5	0	0	0	11	0	5
ID6	IND	0	0	3	11	0	2	0	1	2	11	0	2
	NIP	0	1	2	3	0	1	0	0	2	4	0	1
	Total:	0	1	5	28	0	10	0	1	4	29	0	10
Overburden	DSL	0	0	0	0	0	5	0	0	0	0	0	5
Placement	FED	0	0	0	2	0	14	0	0	0	2	0	14
ID8	IND	0	0	0	0	0	16	0	0	0	0	0	16
	NIP	0	0	0	0	0	7	0	0	0	0	0	7
	Total:	0	0	0	2	0	42	0	0	0	2	0	42
Sediment From	DSL	0	1	0	2	0	2	0	0	1	2	0	2
Borrow Pits	FED	0	0	0	1	0	15	0	0	0	1	0	15
ID9	IND	0	0	1	0	0	15	0	0	1	0	0	15
	NIP	1	0	0	2	0	4	0	1	0	2	0	4
	Total:	1	1	1	5	0	36	0	1	2	5	0	36
Minimize	DSL	0	0	0	5	0	0	0	0	0	5	0	0
Reconstruction	FED	0	0	0	7	0	9	0	0	0	7	0	9
ID10	IND	0	0	0	6	0	10	0	0	0	6	0	10
	NIP	0	0	0	3	0	4	0	0	0	3	0	4
	Total:	0	0	0	21	0	23	0	0	0	21	0	23
ROAD MAINTENANCE													
Grade Roads	DSL	0	0	2	1	0	2	0	0	1	2	0	2
for Drainage	FED	0	0	0	15	0	1	0	0	0	15	0	1
IE1	IND	1	0	2	9	0	4	1	1	1	9	0	4
	NIP	1	3	1	2	0	0	0	3	2	2	0	0
	Total:	2	3	5	27	0	7	1	4	4	28	0	7
Erosion Control	DSL	0	0	2	3	0	0	0	1	1	3	0	0
Functional	FED	0	1	3	12	0	0	0	1	3	12	0	0
IE2	IND	0	2	2	8	0	4	1	1	2	8	0	4
	NIP	1	1	0	2	0	3	0	2	0	2	0	3
	Total:	1	4	7	25	0	7	1	5	6	25	0	7

BMP RATINGS BY PRACTICE AND OWNERSHIP GROUP

		APPLICATION						EFFECTIVENESS					
Practice	Owner	1	2	3	4	5	NR	1	2	3	4	5	NR
Avoid Cutting	DSL	0	0	0	1	0	4	0	0	0	1	0	4
Slope Toe	FED	0	0	0	15	0	1	0	0	0	15	0	1
IE3	IND	0	1	0	9	0	6	0	1	0	9	0	6
	NIP	0	0	0	4	0	3	0	0	0	4	0	3
	Total:	0	1	0	29	0	14	0	1	0	29	0	14
Restrict Use	DSL	0	1	1	2	0	1	0	1	1	2	0	1
When Wet	FED	0	0	0	16	0	0	0	0	1	15	0	0
IE6	IND	0	1	1	13	0	1	0	1	1	13	0	1
	NIP	1	0	2	4	0	0	0	0	3	4	0	0
	Total:	1	2	4	35	0	2	0	2	6	34	0	2
Adequate Drain.	DSL	0	0	0	1	0	4	0	0	0	1	0	4
Aband. Roads	FED	0	0	0	5	1	10	0	0	0	6	0	10
IE8	IND	0	0	0	2	0	14	0	0	0	2	0	14
	NIP	0	0	1	0	0	6	0	0	1	0	0	6
	Total:	0	0	1	8	1	34	0	0	1	9	0	34
HARVEST DESIGN													
Logging Suits	DSL	0	0	0	5	0	0	0	0	0	5	0	0
Topography	FED	0	0	0	16	0	0	0	0	1	15	0	0
IIA2	IND	0	1	0	15	0	0	0	1	0	15	0	0
	NIP	0	0	0	7	0	0	0	0	0	7	0	0
	Total:	0	1	0	43	0	0	0	1	1	42	0	0
Skid Trail	DSL	0	0	0	5	0	0	0	0	1	4	0	0
Design	FED	0	1	2	11	0	3	0	2	0	12	0	3
IIA5	IND	0	1	3	9	0	3	0	2	2	9	0	3
	NIP	1	2	2	2	0	0	0	4	1	2	0	0
	Total:	1	4	7	27	0	6	0	8	4	27	0	6
Landing Size	DSL	0	0	0	5	0	0	0	0	1	4	0	0
Location	FED	0	0	2	14	0	0	0	0	1	15	0	0
IIA6	IND	0	0	3	13	0	0	0	1	3	12	0	0
	NIP	1	1	0	5	0	0	0	0	2	5	0	0
	Total:	1	1	5	37	0	0	0	1	7	36	0	0

BMP RATINGS BY PRACTICE AND OWNERSHIP GROUP

Practice	Owner	APPLICATION 1	2	3	4	5	NR	EFFECTIVENESS 1	2	3	4	5	NR
STREAMSIDE MANAGEMENT													
Adequate SMZ	DSL	0	1	1	3	0	0	0	1	0	4	0	0
Maintained	FED	0	1	5	10	0	0	0	0	3	13	0	0
IIB1	IND	0	2	7	7	1	0	1	1	4	11	0	0
	NIP	0	1	2	4	0	0	0	0	2	5	0	0
	Total:	0	5	15	24	1	0	1	2	9	33	0	0
Stream Veget.	DSL	0	0	1	4	0	0	0	0	0	5	0	0
Maintained	FED	0	0	1	15	0	0	0	0	1	15	0	0
IIB2a	IND	0	0	2	14	0	0	0	0	1	15	0	0
	NIP	0	0	0	6	0	1	0	0	0	6	0	1
	Total:	0	0	4	39	0	1	0	0	2	41	0	1
Retain Bank	DSL	0	0	0	5	0	0	0	0	0	5	0	0
Trees	FED	0	0	2	13	0	1	0	0	1	14	0	1
IIB2b	IND	0	0	2	14	0	0	0	0	3	13	0	0
	NIP	0	0	0	6	0	1	0	0	0	6	0	1
	Total:	0	0	4	38	0	2	0	0	4	38	0	2
Stream Openings	DSL	0	0	0	5	0	0	0	0	0	5	0	0
< 600 Feet	FED	0	0	1	13	0	2	0	0	0	14	0	2
IIB2c	IND	0	0	0	16	0	0	0	0	0	16	0	0
	NIP	0	0	0	6	0	1	0	0	0	6	0	1
	Total:	0	0	1	40	0	3	0	0	0	41	0	3
Equip. Operation	DSL	1	0	0	3	1	0	0	1	0	4	0	0
in SMZ Minimized	FED	0	0	5	11	0	0	0	0	2	14	0	0
IIB3a	IND	0	1	4	11	0	0	0	1	2	13	0	0
	NIP	1	2	2	1	0	1	0	2	2	2	0	1
	Total:	2	3	11	26	1	1	0	4	6	33	0	1
Equip. Operation	DSL	0	0	1	3	0	1	0	1	0	3	0	1
in Wetlands	FED	0	3	0	9	0	5	0	2	1	9	0	5
IIB3b	IND	0	1	3	6	0	6	0	1	1	8	0	6
	NIP	3	1	0	2	0	1	0	3	1	2	0	1
	Total:	3	5	4	20	0	13	0	7	3	22	0	13

BMP RATINGS BY PRACTICE AND OWNERSHIP GROUP

		APPLICATION						EFFECTIVENESS					
Practice	Owner	1	2	3	4	5	NR	1	2	3	4	5	NR
Equip. Operation	DSL	0	0	1	4	0	0	0	1	0	4	0	0
in Streams	FED	0	0	0	15	0	1	0	0	0	15	0	1
IIB3c	IND	0	1	0	16	0	0	0	1	0	16	0	0
	NIP	0	1	0	5	0	1	0	1	0	5	0	1
	Total:	0	2	1	40	0	2	0	3	0	40	0	2
Streams Free of	DSL	0	0	1	4	0	0	0	1	0	4	0	0
Logging Debris	FED	0	0	5	11	0	0	0	0	2	14	0	0
IIB4	IND	0	1	6	9	0	0	0	1	3	12	0	0
	NIP	0	1	3	2	0	1	0	1	2	3	0	1
	Total:	0	2	15	26	0	1	0	3	7	33	0	1
OTHER HARVEST ACTIVITY													
Skid to Min.	DSL	0	1	0	4	0	0	0	1	0	4	0	0
Displacing Soil	FED	0	1	1	14	0	0	0	1	2	13	0	0
IIC1a	IND	0	1	1	14	0	0	0	1	2	13	0	0
	NIP	0	1	1	5	0	0	0	1	1	5	0	0
	Total:	0	4	3	37	0	0	0	4	5	35	0	0
Skid to Min.	DSL	0	1	0	4	0	0	0	1	0	4	0	0
Compacting Soil	FED	0	0	0	16	0	0	0	0	0	16	0	0
IIC1b	IND	0	0	0	15	0	1	0	0	0	15	0	1
	NIP	0	1	2	4	0	0	0	0	3	4	0	0
	Total:	0	2	2	39	0	1	0	1	3	39	0	1
Adequate Drain.	DSL	0	0	2	3	0	0	0	0	2	3	0	0
for Skid Trails	FED	0	0	6	5	0	5	0	1	2	8	0	5
IIC2a	IND	0	1	3	9	0	3	0	2	1	10	0	3
	NIP	1	3	1	1	0	1	0	1	3	2	0	1
	Total:	1	4	12	18	0	9	0	4	8	23	0	9
Adequate Drain.	DSL	0	0	1	3	0	1	0	0	1	3	0	1
for Landings	FED	0	0	0	11	0	5	0	0	0	11	0	5
IIC2b	IND	0	0	2	9	0	5	0	0	2	9	0	5
	NIP	0	0	0	7	0	0	0	0	0	7	0	0
	Total:	0	0	3	30	0	11	0	0	3	30	0	11

BMP RATINGS BY PRACTICE AND OWNERSHIP GROUP

Practice	Owner	APPLICATION 1	2	3	4	5	NR	EFFECTIVENESS 1	2	3	4	5	NR
SITE PREPARATION													
Brush Blades	DSL	0	0	0	3	0	2	0	0	0	3	0	2
Used	FED	0	0	0	5	0	11	0	0	0	5	0	11
IID2	IND	0	0	0	10	0	6	0	0	0	10	0	6
	NIP	1	1	0	1	0	4	0	1	1	1	0	4
	Total:	1	1	0	19	0	23	0	1	1	19	0	23
Scarify Only	DSL	0	0	1	2	0	2	0	0	1	2	0	2
to Extent	FED	0	0	1	7	0	8	0	0	1	7	0	8
Necessary	IND	0	0	3	8	0	5	0	1	2	8	0	5
IID4	NIP	0	1	0	4	0	2	0	1	0	4	0	2
	Total:	0	1	5	21	0	17	0	2	4	21	0	17
Compaction and	DSL	0	0	2	1	0	2	0	0	2	1	0	2
Displacement	FED	0	0	1	5	1	9	0	0	1	6	0	9
Minimized	IND	0	0	7	5	0	4	0	1	5	6	0	4
IID5	NIP	0	1	0	5	0	1	1	0	0	5	0	1
	Total:	0	1	10	16	1	16	1	1	8	18	0	16
Dozer Operation	DSL	0	0	0	3	0	2	0	0	0	3	0	2
on Suitable	FED	0	0	0	6	0	10	0	0	0	6	0	10
Slopes Only	IND	0	0	3	9	0	4	0	0	3	9	0	4
IID6	NIP	0	1	0	5	0	1	1	0	0	5	0	1
	Total:	0	1	3	23	0	17	1	0	3	23	0	17
Limit WQ Impact	DSL	0	0	0	1	0	4	0	0	0	1	0	4
of Fire	FED	0	0	3	6	0	7	0	1	2	6	0	7
IID9	IND	0	0	5	5	0	6	0	1	3	6	0	6
	NIP	0	1	0	3	0	3	0	1	0	3	0	3
	Total:	0	1	8	15	0	20	0	3	5	16	0	20
STREAM CROSSINGS													
Proper Permit	DSL	0	0	0	2	0	3	0	0	0	2	0	3
Obtained	FED	0	0	0	5	0	11	0	0	0	5	0	11
IIIA1	IND	0	0	0	5	0	11	0	0	0	5	0	11
	NIP	1	0	0	3	0	3	1	0	0	3	0	3
	Total:	1	0	0	15	0	28	1	0	0	15	0	28

BMP RATINGS BY PRACTICE AND OWNERSHIP GROUP

		APPLICATION						EFFECTIVENESS					
Practice	Owner	1	2	3	4	5	NR	1	2	3	4	5	NR
STREAM XING DESIGN													
Cross at	DSL	0	0	0	3	0	2	0	0	0	3	0	2
Right Angle	FED	0	0	0	10	0	6	0	0	0	10	0	6
IIIB1a	IND	0	0	0	13	0	3	0	0	0	13	0	3
	NIP	0	0	0	6	0	1	0	0	0	6	0	1
	Total:	0	0	0	32	0	12	0	0	0	32	0	12
Reduce Concen.	DSL	0	0	1	1	0	3	0	0	1	1	0	3
of Runoff	FED	0	0	2	8	0	6	0	1	2	7	0	6
IIIB1b	IND	1	1	0	11	0	3	2	0	0	11	0	3
	NIP	1	2	0	3	0	1	0	2	1	3	0	1
	Total:	2	3	3	23	0	13	2	3	4	22	0	13
Avoid Unimproved	DSL	0	0	0	2	0	3	0	0	0	2	0	3
Crossings	FED	0	0	0	6	0	10	0	0	0	6	0	10
IIIB2	IND	0	1	0	9	0	6	0	1	0	9	0	6
	NIP	1	1	1	3	0	1	1	1	0	4	0	1
	Total:	1	2	1	20	0	20	1	2	0	21	0	20
STREAM XING INSTALLATION													
Min. Channel	DSL	0	0	0	4	0	1	0	0	0	4	0	1
Disturbance	FED	0	0	0	10	0	6	0	0	0	10	0	6
IIIC1	IND	0	0	0	12	0	4	0	0	0	12	0	4
	NIP	1	0	0	5	0	1	1	0	0	5	0	1
	Total:	1	0	0	31	0	12	1	0	0	31	0	12
Culverts Conform	DSL	0	0	1	3	0	1	0	0	1	3	0	1
to Streambed	FED	0	0	1	9	0	6	0	0	1	9	0	6
and Slope	IND	0	2	4	6	0	4	0	3	3	6	0	4
IIIC2	NIP	0	1	2	2	0	2	0	1	1	3	0	2
	Total:	0	3	8	20	0	13	0	4	6	21	0	13
Prevent Erosion	DSL	0	0	1	3	0	1	0	0	1	3	0	1
of Fill	FED	0	3	3	5	0	6	0	4	1	6	0	6
IIIC3	IND	1	4	4	3	0	4	2	6	2	2	0	4
	NIP	1	2	3	0	0	1	1	2	3	0	0	1
	Total:	2	9	11	11	0	12	3	12	7	11	0	12

BMP RATINGS BY PRACTICE AND OWNERSHIP GROUP

Practice	Owner	APPLICATION 1	2	3	4	5	NR	EFFECTIVENESS 1	2	3	4	5	NR
Adequate Cover	DSL	0	0	0	3	0	2	0	0	0	3	0	2
for Culverts	FED	0	0	0	11	0	5	0	0	0	11	0	5
IIIC5	IND	0	0	2	10	0	4	0	0	2	10	0	4
	NIP	0	2	1	2	0	2	0	1	1	3	0	2
	Total:	0	2	3	26	0	13	0	1	3	27	0	13
HAZARDOUS SUBSTANCES													
Comply with	DSL	0	0	0	0	0	5	0	0	0	0	0	5
Regulations	FED	0	0	0	0	0	16	0	0	0	0	0	16
VA1	IND	0	0	0	0	0	16	0	0	0	0	0	16
	NIP	0	0	0	0	0	7	0	0	0	0	0	7
	Total:	0	0	0	0	0	44	0	0	0	0	0	44
Proper Storage	DSL	0	0	1	4	0	0	0	0	1	4	0	0
and Disposal	FED	0	1	2	12	0	1	0	0	1	14	0	1
VA2	IND	0	0	1	15	0	0	0	0	0	16	0	0
	NIP	0	1	1	5	0	0	0	0	1	6	0	0
	Total:	0	2	5	36	0	1	0	0	3	40	0	1
Prevent Entry	DSL	0	0	0	0	0	5	0	0	0	0	0	5
into Streams	FED	0	0	0	0	0	16	0	0	0	0	0	16
VB1	IND	0	0	0	0	0	16	0	0	0	0	0	16
	NIP	0	0	0	0	0	7	0	0	0	0	0	7
	Total:	0	0	0	0	0	44	0	0	0	0	0	44
GRAND TOTALS:		31	111	240	1394	4	777	25	131	192	1430	0	779

600 copies of this public document were published at an estimated cost of $2.50 per copy, for a total cost of $1,500.00 which includes $1,500.00 for printing and $.00 for distribution.